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THE GILLESPIE AEROPLANE AS IT WOULD APPEAR WHEN SOARING.—[See page 501.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

INCREASING THE NEW YORK WATER SUPPLY.

If the citizens of New York understood that the margin between the city's present consumption of water and the minimum flow of the Croton River as recorded in past seasons of drought was of a negative character, the consumption exceeding the supply, they would surely be less extravagant in the use of water, and would make a decided effort to stop the serious waste which daily occurs. Meanwhile the Aqueduct commissioners, pending the construction of the great system of storage reservoirs, which has recently been the subject of favorable action by the New York State Legislature, are rushing the preliminary work for the construction of a new reservoir in the Croton watershed, which will have a capacity of ten billion gallons of water. The new structure, which is to be known as the Cross River reservoir, will impound the waters of a tributary of the Croton River, the area of whose watershed is about thirty square miles. Another dam, to be known as the Croton Falls reservoir, with a capacity of twenty billion gallons, will be located below the Cross River reservoir, and at a point below the junction of the east and west tributaries of the Croton River. These two works will add, therefore, a total of thirty billion gallons to the present total capacity of the various Croton watershed reservoirs, which in the aggregate amounts to sixty-six billion gallons. Although this represents an increase of about 45 per cent, it is a fact that with the new reservoirs completed, the total capacity of the system, in dry years such as have been known, would merely give a safe margin over the present daily consumption of 300,000,000 gallons.

Of the two new reservoirs upon which New York city will have to depend to tide it over until the great reservoirs in the upper Hudson district are completed, the Cross River reservoir is ready for bids, and the Croton Falls reservoir will be in a similar condition during the autumn. The Cross River dam, which will have an extreme height of 150 feet and a length of about 900 feet, will be constructed of cyclopean masonry with a facing of large concrete blocks, the latter having been adopted because they will represent a saving of $250,000 in money, and probably a considerable amount of time; for the securing of cut facing stone in sufficient quantities is in such work always a possible source of delay. During construction the river will be taken care of by two five-foot steel pipes, which will extend through the dam. There will be 248,000 yards of excavation to be done before the rockwork is commenced. In the dam itself there will be 132,000 cubic yards of cyclopean masonry and 6,000 cubic yards of monolithic concrete facing blocks. Some 870 acres will have to be cleared in the bed of the reservoir itself.

Since the element of greatest importance in the construction of the dam, next to its security, is the question of time, the chief engineer, Mr. J. Waldo Smith, is applying to it those methods of construction which enabled him to complete the Croton dam so rapidly. In the first place, on both the upstream and downstream sides of the dam, broad timber trestles will be constructed, to accommodate the railroad tracks that will bring the material to any part of the site. Within the structure of the dam will be built up a series of steel derricks, of the same kind as those used in completing the Croton dam, which were illustrated in the SCIENTIFIC AMERICAN of September 24, 1904. These towers will be inclosed in the masonry of the dam, as the latter is carried up. Three of these towers, 50 feet in height and 25 by 50 feet in plan, will be erected at intervals along the axis of the dam, and each will be equipped with four derricks. When the structure has been built up to a height of 50 feet, five other towers of the same dimensions in plan, and from 20 to 30 feet in height, will be erected, so as to enable the whole length of the dam to be served by the thirty-two derricks which shall be thus available. When the dam has been carried up to the top of these towers, or say to a height of 80 feet, the remaining portion will be built from wooden towers, each carrying one or two derricks, which will be built on the big trestles referred to, which will extend parallel with the face of the dam. The great success which attended this system of construction in the work of completing the Croton dam, is a guarantee that the new Cross River reservoir will be built with unusual rapidity. It is probable that the additional storage of ten billion gallons of this reservoir will be available by the autumn of 1907, and that by the summer of 1908 the Croton Falls reservoir will also be in operation. The total storage capacity of the Croton watershed will then be nearly one hundred billion gallons. Were the rainfall in the Croton watershed uniform from year to year, there would be no cause for anxiety for years to come. It is the possibility of a repetition of certain periods of light rainfall that makes the rapid execution of these two dams an imperative necessity.

THE WARSHIPS OF THE FUTURE.

As the ally of Japan, Great Britain is probably in possession of the facts as to the behavior of the ships and general war *matériel* of the Japanese navy in the present war; and hence the naval programme for the present year, as far as it has been made known by the British government, may be accepted as embodying, in the distinctly novel features of the ships to be laid down, many of the lessons that have been learned. These changes are exactly those which the SCIENTIFIC AMERICAN has predicted would be brought about as the result of the war, namely, a great increase in gun power, and a corresponding increase in speed. Dealing first with the battleship (the foundation upon which a navy is built up, and around which its various elements are gathered) we note that the British Admiralty are to lay down a vessel which, if it proves to be satisfactory, will become the standard type of battleship for probably a decade to come. In the first place, the speed is to be that which only a few years ago was the standard speed for armored cruisers, namely, 21 knots an hour. This would be a remarkable battleship speed, even if sacrifices were made in the armor protection and the batteries; but as a matter of fact, in spite of the high speed adopted, the ship will be considerably larger and more powerfully armed than any battleship built or building to-day, exceeding even the "Lord Nelson" type of last year, which on a displacement of 16,500 tons is to carry four 12-inch and ten 9.2-inch guns.

The new ship will mount a battery of ten 12-inch guns, each of which will have a muzzle energy of about 50,000 foot-tons. All of these guns will be carried in turrets upon the main deck. There will be no intermediate battery; but for defense against torpedo-boat attack, the new ship will be fairly alive with high-velocity 3-inch guns, of which she will probably carry not less than two or three dozen. Steam will be supplied entirely by water-tube boilers, and she will be driven by Parsons steam turbines of 23,000 horse-power. The embodiment of such speed and gun power necessarily implies a great increase in the displacement, which in the new-type ship will be not less than 18,000 tons. The great powers of attack of this vessel can be best understood by a comparison with the two next most powerful battleships in the world, the British "Lord Nelson" and our own "Connecticut"; for while the total energy of a single broadside from the "Connecticut" is 297,000 foot-tons, and that of the "Lord Nelson" 312,000 foot-tons, the seven 12-inch guns of the new battleship which can be brought to bear on either broadside will have total muzzle energy of about 350,000 foot-tons. This is the energy at the muzzle; but since the big gun holds its energy longer than the smaller gun, it follows that at the long battle ranges at which the engagements of the present war have been fought, say three to six miles, a broadside from the new type of battleship, if every shot got home on the enemy, would have about 70 per cent more striking energy than the broadside of the "Connecticut," and about 30 per cent more than that of the "Lord Nelson." Furthermore, because of her excess of speed of about three knots an hour, she would have the "weather gage," and could choose the distance and the position that would be most favorable to herself.

A similar increase in speed and power is to be made in the new design of British armored cruisers, of which four are to be built. With their turbine engines, they are expected to realize a speed of 25 knots an hour. As in the battleships, the 6-inch gun will disappear, and with it the port or casemate method of mounting the gun; and a powerful armament of ten or twelve 9.2-inch guns will be carried on the main deck, all of them within turrets. Like the battleship, these vessels will have the weather gage of any armored cruisers afloat on the high seas; moreover, as the 9.2-inch gun is to be 50 calibers in length, its high velocity and great carrying power will render these armored cruisers a match for many of the smaller and older battleships, that are armed with short-caliber 12-inch guns. One of these 25-knot cruisers could, for instance, circle around the battleship "Iowa," at a range at which the chances of scoring a hit with the low-velocity 12-inch guns on that ship would be rather remote, and because of the flat trajectory of her own 50-caliber 9.2-inch guns, she would be capable, did she carry first-class gunners, of placing her shots with telling effect. Just here, as showing the rapid strides made by modern gunnery, we may mention that the 9.2-inch 50-caliber gun of this cruiser has about the same muzzle energy as the 35-caliber 12-inch gun of the "Iowa," and of course a much flatter trajectory. These four armored cruisers will constitute a squadron, whose 25-knot speed will enable them to refuse battle to the modern battleships; close with any battleships armed with 30 or 35-caliber pieces, and, by virtue of their long-range guns, have the battleships at a great disadvantage.

In the new British destroyers, an even greater relative increase in speed is proposed. Two classes are to be built, one for work off the coasts, and the other for duties on the high seas. As in the case of the battleship, a type vessel, to be followed by others if it proves satisfactory, will be built, and the estimated speed, with turbine engines, is 36 knots an hour. This speed is to be no mere racecourse achievement, run over a measured mile under favorable conditions; for the 36 knots an hour trial speed must be maintained over a distance of nearly 300 knots, or for a period of eight hours' continuous steaming. Five destroyers will also be built which must maintain a speed of 33 knots an hour for a period of eight hours. The coast destroyers, of which a dozen are to be constructed, are to have a speed of 26 knots an hour.

It is significant that in this programme there is no mention made of the building of cruisers of the unprotected class, and herein the SCIENTIFIC AMERICAN finds a further verification of its stated belief that the torpedo-boat destroyer will grow in size, until it has rendered the unprotected cruiser or scout a superfluous type. The new 33-knot ships will probably be of not less than 1,000 tons displacement, and will combine in themselves the qualities both of the scout and the destroyer.

EYE-STRAIN AND HOW IT CAN BE RELIEVED.

In a recent number of the Journal of the American Medical Association, Dr. Lewis S. Dixon, of Boston, makes some interesting observations in regard to the above-named topic. He calls attention to the fact that the eye has always been studied simply as a part of the body, under physiology, and contends that it needed to be studied as an optical instrument, under optics, a branch of science in which our knowledge is mathematically accurate. The usual explanation that eyes are naturally weak and may be rested by an avoidance of work is declared to be erroneous, and the conviction is expressed that no organ of the body should fail to perform its own particular function or show difficulty in its performance unless something is out of order. The proper thing to do, according to Dr. Dixon, is not to give up its use, but to find the trouble, to correct it if possible, and to restore the organ to usefulness.

The writer informs us that the eye varies as much as everything else in the human body. "Each person," he states, "is born with his own pair of eyes; sometimes they are correct, oftener not so. Often they are not alike and cannot work together properly." Vision is corrected by the ciliary muscles, which are made to work; but when they are overtaxed, they are liable to exhaustion and this, in turn, gives rise to serious consequences. It is found to be an actual fact that eye-strain is often the principal factor producing nervous debility, hysteria, melancholia, vertigo, nausea, insomnia, nervous dyspepsia, palpitation of the heart, general nervousness, irritability, faintness, weariness, headaches, constipation, and dozens of other annoying conditions.

Eye-strain, the author maintains, is a permanent waste of nervous energy in correcting the slight congenital and permanent errors in the shape of the eyes. This waste is not felt by a strong, healthy system, but is ready to become a decided tax whenever the system gets below par, and its effects are intensified immensely by continued close work.

When once the muscles have been taxed to the point of exhaustion, and nervous reflexes or disturbances set up elsewhere, then any effort to force the eyes to continue their work may cause actual physical damage requiring a long time to repair. It is like the breakdown that comes from overwork in any other way—repair is slow and sometimes never perfect.

Now that the cause of eye-strain is known, we have the choice of two methods of relief—we may remove the conditions that make it a burden, or we may correct, but not remove, the cause.

Theoretically, the doctor insists, glasses should be worn constantly since the errors are fixed, but if the eyes can once learn how to rest, they are usually able to bear their overwork a fair share of the time without bad results; but they must have rest, and at frequent intervals.

The dislike to wearing glasses is so great and universal, the reason for wearing them so little understood, and the temptation to the oculist to avoid forcing such an unpleasant remedy on his patients is so strong, that they have been worn generally for close

work only, or for temporary relief, and as little as possible. But if glasses are needed at all they are really more beneficial when worn for resting or distant vision than for close work; but that is exactly opposite, the author tells us, to what people wish to do or find agreeable. Too many people decide to follow their own inclination, but are sure to find later that the cost of so doing is much greater than they had expected.

Glasses do not do a bit of the work the eyes ought to do; they simply correct imperfections. In conclusion Dr. Dixon states that, contrary to the general idea, sharp, clear sight, so highly prized and the boast of many, is not the proof or the test of a good eye; for many who have the keenest vision cannot use their eyes much or with any comfort. Easy vision, he maintains, vision that can be used and enjoyed freely, without thought or fatigue, is the proper test of a good eye.

ELECTRIC WAVES AND LIQUIDS.

An Italian scientist, Prof. V. Buscemi, has recently made a series of observations in order to determine the transparency of liquids for electric waves. For such experiments it is necessary to have a very sensitive apparatus for detecting the waves and making the comparative measurements. The author used an apparatus which is based, like Prof. Fleming's, upon the magnetization of iron by the action of the electric waves, but here he uses a galvanometer instead of a telephone. To produce the waves he places the oscillator in an iron case provided with a copper cover. In order to have a complete metallic continuity of the case, the border of the cover has a flange form and dips into a circular groove containing mercury. In one of the sides of the case is a two-inch opening, over which he can dispose a glass tank some 0.25 inch thick. The latter is fixed to the case by a lead cement which is found to be entirely opaque to the electric waves. In this way none of the waves can leave the case without passing through the liquid contained in the tank. By this arrangement Prof. Buscemi found that among the liquids which absorbed the electric waves, the acids occupy the first place, as their absorbing power is greatest. Distilled water is much less transparent than air, and the latter is less so than vaseline oil. A solution of salt (one per cent) is opaque when in a thin layer, also sea water which contains some three per cent of salt. Ether, benzine, and petroleum are more transparent than distilled water, but less so than air.

RECLAMATION WORK IN SOUTHERN CALIFORNIA.

BY C. J. BLANCHARD.

The American Riviera, that beautiful valley in southwestern California in which nestles the delightful city of Los Angeles, is confronted with a perplexing problem. It is a question of water supply to meet the increasing needs of a community growing with remarkable rapidity.

The cultural development and rapid increase of population in the valleys are limited by the available water supply. As far back as a quarter of a century this supply was fully appropriated, and underground sources began to be drawn upon. To-day these wonderful reservoirs, hidden deep in the earth, which the optimistic westerners had come to regard as inexhaustible, are showing signs of giving out. Within ten years the artesian areas in which flowing water is or has been found have shrunk from 375 to 250 square miles, a loss of 33 per cent. The conditions naturally occasion grave concern, for it is recognized that upon the regulation of the acreage which safely may be supplied with underground waters for irrigation, depends in a large measure the future greatness of these coastal valleys.

Several years ago the United States Geological Survey began a systematic study of the peculiar conditions in this district, and very interesting and important data have been collected concerning the geologic and hydrographic features. The people of southern California are squarely facing these problems, and a determined effort on their part is being made to bring into this section new and distant water supplies, not only to provide for present conditions, but to meet fully the needs of the future. Distant watersheds are being examined, and plans for lifting streams from their present beds and carrying them over and through mountain areas, at a cost of millions of dollars, are being discussed in a manner thoroughly characteristic of this progressive people.

Historically, southern California offers one of the most interesting chapters on irrigation to be found anywhere in the arid West. It was during the period when our nation was yet in embryo, before Boston's tea party and the Declaration of Independence had startled the great monarchies of the Old World, that the mission fathers in this far-off valley on the Pacific slope began to teach the Indians the gentle art of husbandry. Coincident with the establishment of the Church, the cultivation of the soil by irrigation was undertaken. With the aid of the Indian converts stone dams were thrown across some of the streams, lines of canals were constructed covering wide areas, and even pipe lines made of burnt tile and mortar were utilized to make tillable the stubborn glebe.

When the American pioneer came to California, attracted by the discovery of gold, he quickly noted the abundant crops of the missions which followed irrigation, and it was not long before many of the abandoned mining ditches were utilized for agriculture.

Early in the sixties of the last century there began an era of substantial development, with works of more permanent and enduring character. By 1880 so precious was the water found to be, and so abundant the rewards following its application to the soil, that practically the entire flow of the streams was diverted and utilized. Stimulated by the very high values of the California citrus lands and the small acreage under irrigation compared with the irrigable area, a thorough investigation was begun of all the possibilities for water development.

The physiographic features of the valley are varied and interesting. The San Gabriel and San Bernardino mountains, which constitute the northern and eastern boundaries of the valley, intercept the moisture-laden clouds from the Pacific. The precipitation on their western slopes forms the perennial streams, the diversion of which has made possible the high state of cultivation that has given some of the orchard lands values of from $500 to $2,000 per acre. Owing to the steep slopes of the mountains, and to the fact that the greater part of the annual rainfall occurs during winter storms of short duration, there has always been a heavy loss of water through floods. The narrow river canyons offer slight opportunity for storage, and but few projects of this kind actually have been constructed.

These valleys and plains are not normal, but are made up of a series of deep filled troughs separated by ridges, which rise higher and higher toward the interior. These troughs and their separating ridges have been formed by geologic processes. The rivers, having existed before the geologic period which created the troughs and ridges, have maintained their way across them from the higher mountains to the sea, cutting their channels through series of ridges and filling the intervening basins with sands, gravels, and clays. As the streams emerge from the mountain canyons their velocity is lessened, and the heavier bowlders, gathered by erosion, are first deposited. The deposit becomes finer and finer as the streams proceed, until the tiny particles which sift downward form a sheet of impervious clay. These clay caps slope with the streams, and the water percolating through the gravels of the basins accumulates behind them, gathering pressure from the ever-increasing weight of waters, and producing artesian wells wherever the clay covering is pierced. When the underflow encounters the ridge at the outlet of an upper valley, the water is forced to the surface, and flows on to the next basin where, unless diverted, it sinks into another gravel-filled basin. These basins are not only storage reservoirs, but act as effective regulators of the hide-and-seek rivers, protecting them from evaporation and contamination, and producing a remarkable uniformity of flow at the canyon.

The history of irrigation in this valley is one of steady growth and development. Southern California now leads the United States in the diversity of methods of application, in scientific and detailed distribution, and in the expensive character and boldness of design of its irrigation works. All the irrigation conduits are either cement-lined canals or pipes. The irrigation systems in this part of the State are known all over the world. Surface water, drainage water, seepage water, water from artesian wells, from tunnels penetrating the mountains, and waters impounded in reservoirs are alike utilized.

This intensive development was partly the result of a series of dry years which began about a decade ago. The preceding ten years were years of unusual rainfall, and the acreage brought under cultivation was in excess of that which could be supplied by surface streams when the dry period came on. California's most important and valuable crops are perennial plants, citrus and deciduous fruits, and walnuts, and the failure of the water supply for a single season means an enormous loss to the irrigator. The successful installation of the Gage canal system, which was completed in 1886 to cover 7,500 acres of citrus lands, and which furnished a splendid example of the feasibility of utilizing the underground waters, gave an impetus to the development of this source which has been continued until now there are nearly 3,000 wells and about 1,600 pumping plants in operation, representing a capital of approximately $3,500,000, and having a combined continuous flow of from 400 to 500 second-feet. There are few important irrigation systems whose supply has not been augmented during the past ten years by artesian or pumped waters, to make up the deficiency in stream flow.

While the underground reservoirs, which have proven of incalculable value to the irrigators of southern California, are of such enormous extent that they more than compensate for the lack of storage facilities, the fact can no longer be overlooked that the drain put upon them in the past few years has resulted in a notable decline in the water levels. A system of observations upon the fluctuations of ground-water levels is in progress under the direction of the United States Geological Survey, but it will be of increasing value if continued for a period of years. One notable fact has been discovered. The water level has been steadily declining, even in years of normal rainfall, so that the reclamation of virgin lands through the indiscriminate increase in the number of wells is a menace to the present irrigation systems. A series of years of increased rainfall may possibly restore the volume of ground water, but it is an unsafe assumption to make in the absence of scientific records showing this to be a fact.

ENGINEERING NOTES.

Like so many other details not only in marine engineering but in other lines of work, features which are introduced in a practical way in recent times are found to have a comparatively ancient origin. This is true of the water tube boiler, which in its recent use dates from about 1880. The excavations at Pompeii have shown small boilers almost identical in construction with some of the best of our water tube boilers, although they were doubtless only used for a circulation of hot water.

During the official trials of the new turbine steamer "Onward" for the Dover-Calais channel service of the South-Eastern Railroad, a record for this class of vessel was established. The "Onward," which was built by the Messrs. Denny Bros., of Dumbarton, is practically a sister ship to the "Queen," which has been plying upon this route for many months past with complete success. A large number of improvements, however, have been embodied both in speed and comfort. In the mile run on the Firth of Clyde, a mean speed of 22.54 knots was attained. Another noteworthy feature of the trials was the remarkable speed of fifteen and a half knots which was attained with turbines reversed. The "Onward" will be able to cover the distance between Dover and Calais in 45 minutes, which is an acceleration of ten minutes upon the scheduled time of the sister ship "Queen."

Municipalities have a right to insist upon the abatement of black smoke by all users of steam boilers, without regard to the purposes for which the steam is used or the means to be adopted for abatement. This, because smoke is a public nuisance and because it can be abated without hardship to the owner of the plant. Nevertheless, when the evil is present and has been present for a period of years, it is not good policy to be too radical in the enforcement of the statutes. The law should be definite and stringent and the penalties adequate, but they should be enforced with discretion by officials who have some technical and practical knowledge of smoke abatement. It is absurd to talk of putting this matter into the hands of the police or of the health officer. The official having charge of this work should be a trained engineer, if possible a technically educated man, and he should be entirely above graft in any of its disguises.

German papers state that acetylene gas, generated from calcium carbide by the simple addition of water, has not met expectations, which, however, were very great. On account of the ease with which a gas for lighting purposes could be obtained, it was believed that it would be used very extensively, but the boom in the acetylene industry did not last long. New uses for the gas have been looked for for some time. The latest invention is its use as an explosive. By means of an air mixture, explosive force is obtained which can compete with that of powder and dynamite. The explosion takes place in an air chamber and is caused by an electric spark. For this purpose carbide of calcium is reduced to small particles and put into a cartridge, consisting of a tin box. In this the carbide lies at the bottom and above it is a partition filled with water. Above this is a vacant space with the electric percussion device. On the side of the cartridge is an iron pin by means of which the partition between the carbide and the water can be perforated. After the drill hole has been completed the cartridge is placed into it and the hole is closed with a wooden stopper. Then the protruding iron pin is dealt a blow, by which the partition is perforated and the water is caused to come in contact with the carbide, whereby acetylene gas is generated. This mixes with the air of the drill hole. After five minutes the gas is ignited by an electric spark. By this method of blasting the rock is said to be not thrown out but rent with innumerable cracks, so that it can be easily removed afterward. About 1.7 ounces of carbide, which produce about 16 quarts of acetylene gas, is used for each cartridge.—Mines and Minerals.

At the commencement exercises of the Western University of Pennsylvania, the honorary degree of Doctor of Science was conferred upon Dr. Marcus Benjamin, of the United States National Museum, whose name will doubtless be familiar to the readers of the Scientific American as that of a frequent and valued contributor.

THE DEVELOPMENT OF A MOLLUSK.

Scattered all along the Atlantic coast, from Labrador to Florida, is a genus of mollusk known to zoology as *Crepidula* which, despite its abundance, has been so little studied that only comparatively recently has anything definite about its embryology been known. To Prof. E. G. Conklin, of the University of Pennsylvania, we owe the first account of the life history of crepidula. With the results of Prof. Conklin's inquiry before him, Dr. Dahlgren, head of the department of preparation of the American Museum of Natural History, has directed the making of a series of models to illustrate the life history of crepidula, of which models the accompanying illustrations are photographs. The models excellently show those series of active changes which take place in the nuclei of a living cell in the process of division, changes which are designated by the general name karyokinesis. Furthermore they show that many of the organs of the fully-formed animal may be traced back to certain individual cells in the early division stages of the egg. Each of these first-formed cells has its own peculiar shape, size and position, and it invariably gives rise to a particular organ, or part, of the developed animal.

In Fig. 1 we see the undeveloped egg of the crepidula. The two dark spots represent the male and female, or sperm and egg, nuclei which do not fuse before the appearance of what is known as the division spindle. The dark zone represents the animal pole of the egg, or the protoplasmic portion; the lower or more lightly tinted part is the yolk, constituting the vegetal pole of the egg. Two polar bodies are invariably thrown off during the maturation of the egg, which precedes its union with the spermatozoon. Every nucleus contains a substance known as chromatin, which, in the process of division, forms various colored figures, such as disks and threads.

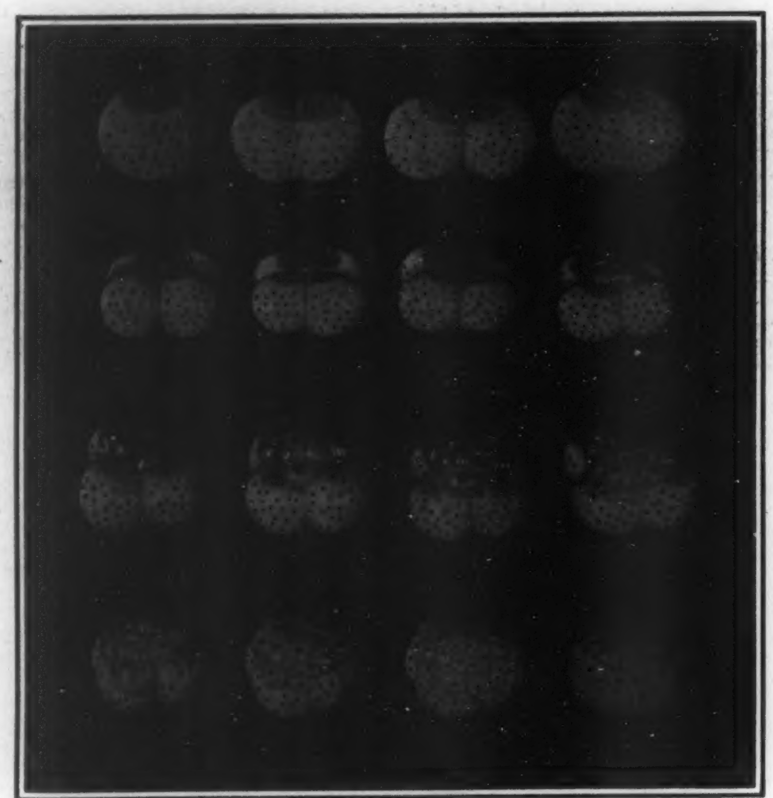
After the chromatin has been distributed equally to the two poles of the division spindle the cell body begins to divide, as shown in Fig. 2. The egg elongates and the entire cell is constricted about the central axis. The cell body then divides into two equal portions, which are at first nearly spherical and touch each other only at a comparatively small surface, as shown in Fig. 3. Each of the halves thus formed has its own nucleus, the two nuclei shown in Fig. 1 having each given up half of its material to form one of the new nuclei. Later the two cells are more closely pressed together and the surface of contact becomes larger, so that each cell forms a hemisphere (Fig. 4). One of these cells forms the anterior half of the future animal, the other the posterior half.

The peculiar karyokinetic markings, shown in Fig. 4 by the four black spots at the upper pole of the egg, indicate that when the cell has reached this stage, another cleavage is about to occur in a plane at right angles to the first. Two fairly independent furrows are produced, appearing near the animal pole and running around until they reach the vegetal pole, forming four blastomeres of approximately equal size. The same elongation of the two cells which characterized the beginning of the process of cleavage, as illustrated in Fig. 2, again takes place. Each nucleus during division breaks into what are known as division spindles, the production of which also marked the first cleavage (Fig. 2). In Fig. 6, the second cleavage is shown complete. This second cleavage lies in the median plane of the future animal and divides its body into right and left portions.

Up to this time, cleavage has been equal. There have been two cleavage planes at right angles to each other; but now another phenomenon takes place. The next cleavage gives rise to four small protoplasmic cells at the animal pole of the egg. These are the first beginnings of the ectoderm, which is subsequently to envelope the whole egg and become the integument of the animal's body (Fig. 9). The head and brain of the future animal come from these four small cells.

In Fig. 9, the beginning of the fourth cleavage is indicated by the separation from the larger cells of another quartette of small ectoderm cells. These develop until they assume the size and shape shown in Fig. 10. As the animal continues to grow by this process of division, the first quartette which was formed in the stage shown in Fig. 8 has been split up into eight cells, so that we now have twelve ectoderm cells in all (Fig. 11). The karyokinetic figures in the larger cells indicate that the separation of a third quartette of ectoderm cells is about to take place. The second and third quartettes give rise to all the ectoderm of the future animal except that over the head. A large cell is now formed at the posterior pole of the egg (Fig. 13) which contains all the substance of the middle layer or mesoderm of the future animal. The four lower large cells, which now, after separation from those of the ectoderm and mesoderm, consist entirely of entoderm cells, are destined to form the internal lining of the future mollusk's digestive organs. Tracing the process of evolution still further we find that in Figs. 13 and 14 the ectoderm cells have increased by simple division until they cover the top of the entire egg. Finally, in the stage represented in Fig. 16, these cells are shown all but surrounding the embryo. Soon they completely surround it, leaving only a very small opening—the mouth (Fig. 17). The embryo now assumes a more decidedly ovoid shape. Certain lines of cells shown in Fig. 17 develop into outgrowths or projections, constituting the more striking features of Fig. 18. These outgrowths are the head at the top and the velum which lies below it; the foot in the center, with the mouth a mere cavity above it; and at the bottom a gland which secretes the shell. In Fig. 19, we find these outgrowths have more pronouncedly developed into the forms they will ultimately assume. The velum assumes almost a mushroom-like appearance. Finally we have the fully developed larva or veliger, shown in Fig. 20. Here we see the velum with its several rows of cilia, which are nothing but swimming organs highly essential to a sessile mollusk, because the animal is dependent upon them for the distribution of the species. In Fig. 21, we have a median section of the completely developed mollusk, each of the parts being properly labeled.

The terms velum and veliger require some explanation. The velum, as its name indicates, is a veil or sail which is a highly characteristic ciliated formation of the molluscan embryo serving as an organ of locomotion in that stage when the embryo is called a veliger. It is usually soon lost, but in some cases it is retained permanently in a modified form.



The First Stages of a Mollusk's Growth.

The Last Stages of a Mollusk's Growth.

THE DEVELOPMENT OF A MOLLUSK.

New Fire-Damp or Gas Indicator.

A new automatic apparatus for indicating the presence of illuminating gas or fire-damp in the atmosphere has been brought out by Messrs. Hauger and Pescheux, of Paris. The apparatus is composed of a very sensitive balance which carries at one end of the beam a tight recipient containing ordinary air, while it is balanced at the other end by a plate having the same surface. Thus the apparatus is at rest when the surrounding air is in the normal condition for respiration. Should the composition of the air change, its density is modified according to the amount of gas which is mixed with it. In this case as the air which the vessel contains is invariable, seeing that the vessel is tight, the balance is destroyed. If the foreign elements are lighter than the air, the vessel goes down, and the reverse is the case where the mixture becomes denser than the air. The balance is arranged so as to plunge a needle into a mercury cup and close an electric circuit. Thus a bell can be rung or other apparatus worked even at a distance, and this can be of great utility for mines. In the case of private apartments the current can be made to operate an automatic device for opening a window, ringing an alarm bell at the same time. As the needle is regulated at will, we can make the apparatus work for any desired degree of the gaseous mixture. In order to neutralize the atmospheric influences of temperature and pressure, the inventors use two compensating devices which are mounted upon the scale beam. One of these is used to correct the pressure variations and consists of an aneroid chamber which acts on a multiplying lever so as to displace a rider along the scale beam, thus keeping the balance constant under varying air pressures. Heat influences are compensated by a composite metal spiral which acts upon a lever and shifts a rider upon the beam in the same way. When once it is accurately calibrated, the instrument is invariable at different temperatures and pressures.

The power generated in a modern steamship in a single voyage across the Atlantic is enough to raise from the Nile and set in place every stone of one of the great pyramids.

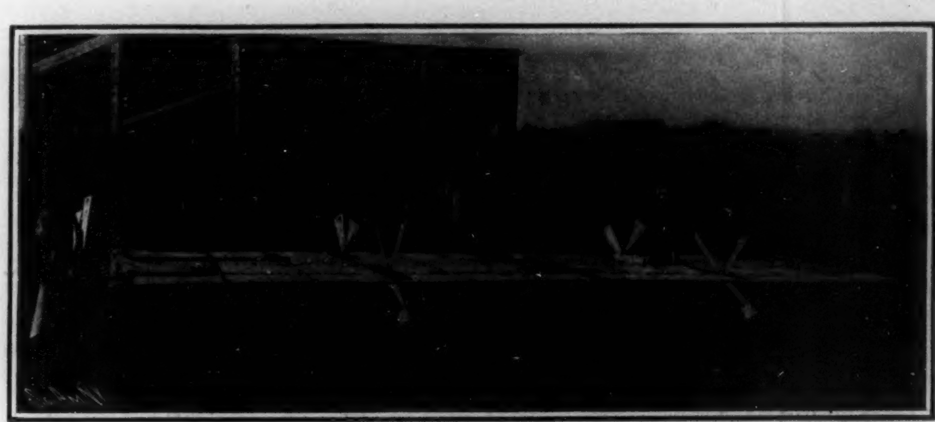
THE GILLESPIE AEROPLANE.

BY CHARLES B. HAYWARD.

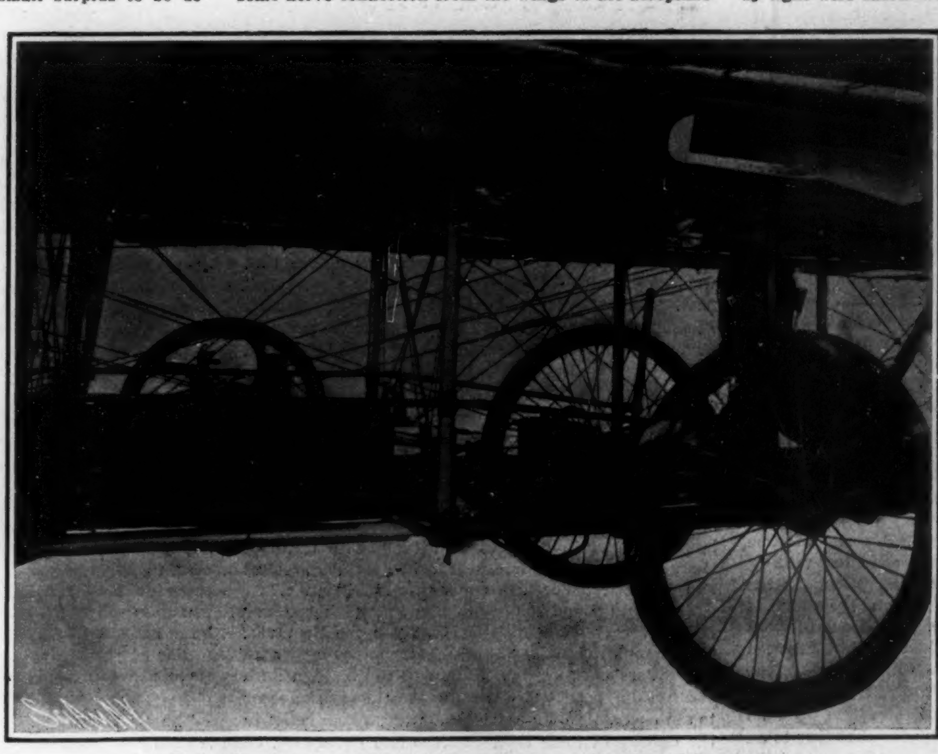
Aeronauts may well be divided into two general classes, although there are many subdivisions of each which might be deemed to be of sufficient importance to be classified individually. Of the two sharply divergent schools under which all others may be brought for the sake of convenience, the first may well be said to consist of those followers of Montgolfier who still pin their faith to the balloon, but in the present state of the art have made dirigibility their aim. The other general class comprises that army of investigators who have discarded the lifting power of gas and depend solely upon plane surfaces and mechanical propulsion for this. There are so many subdivisions of this last class that it would be hopeless to attempt to enumerate them, but probably they can all be brought under two heads—the followers of the fixed aeroplane idea moved by propellers or something similar, and those in which the movement of the planes themselves is relied upon to produce this, as do the wings of the bird in nature. Experiments in both fields date back for more than half a century, and it is not at all unlikely that attempts have preceded this by many years, but have gone unrecorded. How to impart sufficient speed to the apparatus to overcome the wind pressure is the problem presented in both instances, and its solution is in either case attended with difficulties that appear well-nigh insurmountable.

The lifting power of hydrogen is so small compared with its volume that in order to provide sufficient latitude to cover the weight of motive power, crew and accessories, the size of the envelope must be increased until the area it presents makes the factor of wind pressure absolutely prohibitive. In order to combat the latter at all a horse-power entirely out of proportion with the weight of its generator is imperative and the available capacity of the latter is restricted within closely defined limits by the small surplus to be devoted to this purpose after the lifting power of the balloon itself and the crew has been deducted, and this in turn determines the possible speed. That this is closely restricted is evident, for the resistance grows as the square, and the horse-power required as the cube, of the speed.

The principle of the dirigible balloon has been pretty well evolved, but the maximum attained with this type has been a speed of 18 miles an hour—Count Zeppelin's balloon—and a distance of five or six miles. On the other hand, a balloon has made a sustained flight of twelve hundred miles, with the wind. Thus the only practical advance over first principles has been found in the dirigible balloon, but while the latter has the advantage of providing independent flotation its many disadvantages are apparent, and at best, though it may serve useful ends in war or exploration, it is a costly toy with which few but governments can afford to experiment.



The Aeroplane Ready to Start.



View Showing the 20-Horse-Power Motor and Position of Operator.

THE GILLESPIE AEROPLANE.

There is an element that must perforce be lacking in every attempt of man to imitate the flight of the bird and that is the spark of life—the nerve center that man has never succeeded in endowing any of his creations with. Many of the attempts to reproduce the bird's flight have been crude and fanciful, although they are of some value to science. On the whole there is no difficulty in merely simulating the movement of a bird's wings nor in reproducing the surfaces its wings present to the air.

When man steps on the "yellow peril" in the shape of a banana skin and is threatened with a sudden loss of his center of gravity, a subconscious effort flashed from his nerve center pulls him up, and in the majority of instances saves his loss of dignity if nothing more. It is the same with the bird; violent gusts of wind from every direction strike it on all sides in its flight, but this same subconsciousness with which all beings of a sufficiently high order are endowed suffices to save it from being capsized in the air or blown against obstructions in its path. Whatever it may be termed, intuition, instinct, or an unknown quantity, it is this unconscious effort made in far less time than it would be possible to accomplish any voluntary movement that preserves the center of gravity.

If illustration were needed that this is the *sine qua non* without which the true flying machine is a practical impossibility, it is only necessary to revert to the many fatalities that have ended man's attempts to fly in various instances. Every aeronaut who has reached the stage of making practical experiments in aviation has had to recognize that provision for shifting the angle of incidence and for preserving the equilibrium is a matter of paramount importance—indeed, a condition precedent to any extended flight.

"Upset in the air" tersely explains the deaths of Lilienthal and Pilcher, who demonstrated a great deal in their numerous gliding experiments, but nothing so conclusively as the fact that until there can be some means of automatically preserving the equilibrium—some nerve connection from the wings of the aeroplane to the nerve center exemplified by its operator—no amount of skill or dexterity on the part of the latter can suffice to save him in the end. Even the birds are at times suddenly "up-ended" in battling against the gale, and their recovery is due solely to this force of unconscious cerebration that does the right thing at the right moment without conscious effort. But should the bird actually meet with disaster in the shape of capsizing, the chances of recovery before striking the ground are so great that the latter seldom if ever occurs. In the case of the aeronaut recovery is out of the question.

Probably the chief reason why more has not been accomplished with the aeroplane lies in the fact that such meager opportunities to study it in action have been presented. "Defective equilibrium" epitomizes the failure of practically every attempt at flight with a true flying machine since experiments have been made along this line. Shifting the weight of the operator to vary the angle of incidence and numerous devices to shift the planes, the addition of side planes, tails and similar devices to accomplish the same object—all theoretically correct—have been found to fail when put to the test. It is the claim of G. Curtis Gillespie, of New York, who has made a close study of the subject along this particular line for a number of years, that in his flying machine principles are embodied that permit of the operator's becoming imbued with a sensitiveness to the movements of the aeroplane when in flight that, with a little experience, the closest approach ever made to this same subconsciousness of the bird will be attainable.

The effective area of the Gillespie aeroplane is approximately 240 square feet, and the designer, while being perfectly familiar with the great advantages of the curved plane, is confident that with the great amount of power developed by the seven aluminium propellers, each of which is slightly over three feet in diameter, the form of plane used in this machine is not only very much more difficult to "up-end" when in flight, but is likewise not so easily capsized laterally, this being a fatal defect in many of the extremely light machines with curved planes. This small plane is moreover more easily handled than an extremely wide convex plane or several of them, as usually adopted.

The dimensions of the machine are 24 feet over all with a beam of 10 feet, the plane being of light duck, its surface being cut into at each end to provide for aluminium movable planes in order to vary the angle of incidence. In order to do this, they are connected by light wire cables with an aluminium wheel directly in front of the operator, and this is his sole duty while in the air, upon this fact being based his ability to emulate the subconsciousness of the bird in flight.

The body is suspended from the plane by means of a trussed frame of light aluminium tubing reinforced by piano wire which also serves the purpose of stiffening the wind-bearing surface and preventing any deflection under pressure.

The motive power consists of an air-cooled gasoline engine having six cylinders, opposed three to three in a horizontal plane with cranks set at an angle of 60 degrees. The machine's total weight is 150 pounds, the cylinders having a bore of 3¼ by a stroke of 3½ inches, and at 2,000 revolutions per minute it develops 20 horse-power, or an effective horse-power for every 6.15 pounds of metal.

With this power each of the propellers has shown an effective pull on a scale of 7 pounds and a fraction, or for the total number approximately 50 pounds, so that at maximum speed a lifting power of some 2,400 pounds is commanded. Complete with operator the total weight is 450 pounds.

In an article on "Guns for the Defense of the Outer Harbor," Capt. James F. Howard, United States Artillery Corps, states that of the large-caliber guns already mounted in partial completion of the project of coast defense as determined by the "Endicott Board," 93 are 12-inch, 119 are 10-inch, and 93 are 8-inch.

Correspondence.

The Invention of the Montgomery Aeroplane.

To the Editor of the SCIENTIFIC AMERICAN:

In the very fine account of the Montgomery aeroplane in your last issue, I take notice that I am credited as a collaborator with Prof. Montgomery in the invention of the machine. I would like to state through your columns that in this relation I have had nothing absolutely to do with it. The invention pure and simple is the work of Prof. Montgomery himself.

R. H. BELL, S. J.

Santa Clara College, Santa Clara, Cal., May 24, 1905.

The Moving Ball of Stone.

To the Editor of the SCIENTIFIC AMERICAN:

If the ball is of polished stone, and the base of unpolished stone, then, I think, the ball (if unfixed) would move under the influence of the heat of the sun. For the base would heat more quickly and, necessarily, cool more quickly than the ball.

But I do not think this can account for the regular motion to the south. Under the heat of the sun it would appear the motion should be a little west of south, with a possible cross rotation to the east.

If the motion be quite regular, it must be referred to some fixed physical relation between the ball and its base. If referred to the sun, its motion must vary.

F. C. CONSTABLE, M.A., Trin. Col. Cam.

Wick Court, England, May 17, 1905.

The Stone Ball.

To the Editor of the SCIENTIFIC AMERICAN:

The account of the stone ball's movement interests us here, as we have two similar balls which have not moved since they were placed upon their bases. One of them has been in position fourteen years. It is a polished granite, resting on a thin sheet of lead, in a saucer-like depression eight inches in diameter, on the top of the unpolished granite base. The other ball rests upon four pyramidal points about four inches high, standing twelve inches apart in a square on top of base. Both are of granite. The ball is polished. We have near the cemetery shocks from rock blasting and heavy freight railroad trains. It seems incredible that any shock short of dynamite or seismic could lift so heavy a ball nearly half an inch from its flattened disk, and roll it on its polished circumference. In this position and in its roomier basin would make more plausible various causes that have been given.

If the tables of expansion of granite by heat are correct, namely, 0.0000045 to 1 for every degree of heat (F.) then it will not account for the movement of that ball from August to April 15 of over five inches, as a variation of temperature of 20 degrees daily for 250 days, operating on the 8-inch base upon which it rests, would not altogether be more than the fractional part of an inch.

A workman of average weight on opposite sides of monument operating seven-foot levers on fulcrums four inches from the ball could readily, by a downward and slight lateral movement, lift and rotate the ball with ease. SECRETARY WARWICK CEMETERY.

Warwick, N. Y., June 1, 1905.

The Motion of a Rolling Wheel.

To the Editor of the SCIENTIFIC AMERICAN:

As many erroneous conclusions have been drawn from the conception of a wheel as turning about its point of contact with the rail or ground, particularly in efforts to improve the counterbalancing of locomotives, I would ask the privilege of adding some related facts to your reply to query No. 9622 in the SCIENTIFIC AMERICAN of April 22. There is an important difference between the condition of a body (or a part of a body) which is motionless for some interval of time and that of a body having an ever-changing velocity which is 0 at the instant under consideration. In the first instance there is no acceleration, and the body has no unbalanced force acting on it. A stone resting on the ground has the attraction of the earth just balanced by the pressure of the material on which it rests, and no unbalanced force acts. But, if the stone is thrown vertically into the air, there is a time when its formerly decreasing, upward velocity is changing to an increasing, downward velocity; and at that instant the velocity of the stone is 0. The attraction of the earth is practically unbalanced. From Newton's laws of motion it follows that, when a body has an unbalanced force acting upon it, it has an acceleration. The stone, then, has an acceleration of 32.16, even though its velocity is 0. The piston of an ideal engine, at the end of its stroke, has a velocity of 0. It does not stand still for a millionth of a second, or for any interval of time whatever; its velocity simply passes through the value 0; but it has then its maximum acceleration.

It seems to make clear the motion of a rolling wheel to consider the wheel as turning at a uniform rate about a point on its rim while that point travels over a cycloidal path. When the point touches the ground, its velocity will be passing through its 0 value, and the velocity and direction of motion of every point on the wheel will be the same as if a shaft in fixed bearings in the ground passed through the point in the rim. The point is, therefore, called the "instantaneous center." But it then has a maximum acceleration; so the *forces* acting on the wheel are totally different from what they would be if the wheel turned about the shaft assumed above.

The actual path of the center of gravity of the wheel is a straight, horizontal line if the center of gravity is at the center of the wheel, and a prolate cycloid if it is "off center." If the wheel turned about a point on the ground, the path of the center of gravity would be a circle. The radii of curvature of the two paths at any point will not be the same. Therefore, since change of motion must be proportional to the forces that produce it, we have another proof that the forces acting on the wheel would not be the same in the two cases.

Now calculations of forces and accelerations, based on a rotation about the instantaneous center, will, if the acceleration of the instantaneous center itself is taken into account, give just the same results as the simpler calculation which considers the wheel as turning on its center while the center has a motion of translation in a straight line; while any calculation which neglects the acceleration of the instantaneous center will lead to absurd results. For example, such a calculation would require that, at a speed common on passenger trains, the centrifugal force of the wheels would lift the whole train from the rails.

Waltham, Mass., May 24, 1905. G. F. STARBUCK.

Can the Baalbec Stone be Moved?

To the Editor of the SCIENTIFIC AMERICAN:

I take advantage of an almost unprecedented rainstorm at this season in California, housing a busy man, to ask you if it would be a physical impossibility for modern mechanics to move to the shores of the New World the huge stone in the quarry at Baalbec, which evidently stumped the ancient builders of the great sun temple there. On the occasion of my visit there on horseback when completing a tour of Palestine, this was the question I brought away with me. If the ancients could quarry and put into the walls of a lofty building stones shaped and sized like box cars, passenger coaches, and the very largest Pullman sleepers, could moderns, with steam power and all the inventions of the later centuries, handle the mighty Baalbec stone? I can only give from memory approximate measurements. The stone is about 80 feet long, 18 feet wide, and 13 feet thick. It is estimated to weigh fifteen hundred tons. I can make only this contribution to the conditions of the case. When representing the United States Treasury Department, and inviting the various governments of the world to send their most wonderful achievements for exhibition at Chicago, this stone of stones fascinated my attention. From Baalbec to Beirut, from the back of a splendid Arab horse, I studied the roadway to the sea. Were the Sultan to give that mighty carved rock to America, to be put up as a tribute to the energy of a people who can build a Panama canal, there is not (or was not in 1893) a house that would need to be moved, or a tree that would need to be cut, to move the stone to a completed float. The boulevard is hard, wide, modern, splendid. The picturesque stone would interest your readers. My photograph of it is imperfect, or I would send it to you.

EDWIN SIDNEY WILLIAMS.

Saratoga, Cal., May 26, 1905.

Ethics of the Russo-Japanese War.

To the Editor of the SCIENTIFIC AMERICAN:

In your excellent editorial, "An Unparalleled Victory," you attribute, with much verity, the marvelous success on land and sea to the Japanese people themselves—to certain inherent qualities and to traits of character, most admirable, acquired by training, ethical and Oriental, "older than our western civilization."

There you sound the keynote, but permit me to say that the very characteristics that you mention, viz., "intense patriotism, self-denial, scrupulous honor in all matters affecting the welfare of the state, a keen sense of duty, strict discipline, unquestioning obedience to authority, absolute unity of purpose, a firm belief in the destiny of their race, patience and endurance, an absence of self-consciousness and posing that may well put our 'white' civilization to the blush, a close attention to detail, and lastly a combination of great prudence and forethought with a marked ability to adapt themselves quickly to the circumstances of the hour," are, with one or two exceptions, common to Russian and Japanese alike.

The "Ice Palace" of St. Petersburg melts away into utter insignificance under a tropical sun. Many of the excesses of the Russian garrison at Port Arthur, on the eve of its surrender, were committed with suicidal intent. The Japanese soldiers, like the Chinese, committed suicide rather than be taken prisoners. Many Russians did the same, but not on the open field, in the face of the enemy.

Russia is not disintegrating, as a nation, an empire. Notwithstanding all internal dissension and revolutionary plots, "intense patriotism" is a trait predominant in the Russian breast. Pride of country, of race, of nationality, is strong with the Russian peasantry, who hardly could define an absolute monarchy, and who venerate the power of the Czar, their "Great Father," temporally, in much the same manner as they revere the Universal Patriarch, the head of the Greek Church, spiritually. Neither church nor state in Russia favors the education of the masses, nor their elevation in the social scale, whereas, in Japan, it is just the reverse. The national government in Japan has adopted many of the customs and progressive methods of the United States, is open to all religions, zealous for education for all classes, eager to promote the best interests of her people, intellectually, physically, materially, spiritually.

Thus it will be seen that "self-denial" is inculcated and practised by the Russian as well as the Japanese, for his country, and for his religion's sake; also "scrupulous honor," and " a keen sense of duty." But ignorance and fear are the conditions under which the Russians live and die, fight and lose; intelligence and trust those with which the Japanese win. "Strict discipline," too, we find on both sides. The discipline of the Russian army and navy is not only strict, it is brutally severe. It is systematically cruel. That is its great defect. Military plans may be well laid, the tactics of the latest and best schools may be employed; every modern device, and newest invention, and additional improvement known to any warfare be adopted, but if the discipline be too severe on the one hand or too lax on the other, the colors will go down.

"Unquestioning obedience to authority" is by no means restricted to the "Land of the Rising Sun." On the steppes of the Russias and in bleak and dreary Siberia that trait is found, is made compulsory, not in the army and navy alone, but in the home. "Absolute unity of purpose" is seldom if ever found, in frail humanity, even in this country, not to mention Russia; hence, we will concede that to the Japanese, for the present, at least.

And in Russia, as well as Japan, we find "a firm belief in the destiny of their race, patience and endurance," also. As to "an absence of self-consciousness," every soldier, of any nationality, should have that almost pre-eminently, if he is to be a good fighter and win laurels for himself. "Posing" is necessary at times, alike with rank and file. Parade drills teach that to both officers and men, even in times of peace. In battle, there must be delicate and accurate maneuvers, which require not only skill and plenty of posing and self-consciousness, but self-sacrifice, as well.

Every army knows the importance of "a close attention to detail," and that has heretofore been as marked in Russian successes as, during the entire course of this war, in their constant and successive series of defeats. We may say that the Japanese excelled the Russians in this respect, but certainly the latter were not lacking therein.

The strongest characteristic is the last, "a combination of great prudence and forethought with a marked ability to adapt themselves quickly to the circumstances of the hour." That is essentially Japanese. With marvelous rapidity they struck their blows, with unerring aim at the foe's weakest and most exposed points, meanwhile availing themselves of the best strategic bases of operation.

The Japanese in every engagement seemed to possess a hidden insight, not only "forethought," but foreknowledge of all the enemy's plans and positions. The Russians took every precaution, as they thought, to protect themselves from traitors within their own ranks, and from Japanese spies; but the result was always the same. The intelligence was conveyed from one to another with Oriental rapidity. But the Japanese did not rely upon such intelligence alone. From the Occident, they had previously fortified themselves with the best munitions of war, they had acquired materials and resources and financial backing, of which the world at large knew nothing. MRS. EDWARD P. FOSTER.

Cincinnati, Ohio, June 14, 1905.

The Current Supplement.

The petroleum and coal fields of the Pacific coast of Alaska is the subject of the opening article in the current SUPPLEMENT, No. 1538. Dr. Richard Lucas writes briefly but instructively on the Coloration of Glass by exposure to the light. How a vertical sun-dial can be made is very exhaustively described and illustrated in a well-written article. Why is the silica brick better than the clay brick? An answer to the question will be found in an authoritative discussion of the subject. The Hammurabi Code is without doubt the earliest legal document extant. In the SUPPLEMENT a splendid comparison of this ancient code with the Code of the Covenant, with which it has much in common, is drawn by Prof. Max Kellner. Dr. E. Branly, whose name will be forever linked with the invention and commercial introduction of wireless telegraphy, writes on an Experimental Study of Electric Waves and Their Applications.

Cultivation of Chicory in Belgium.

During the months of January, February, and March attention is attracted to the immense quantity of a special vegetable sold by marketmen, greengrocers, and hucksters, and eaten by all classes throughout Belgium, prepared in various appetizing manners, and frequently eaten as a salad, either raw or cooked. I refer to the white chicory, the cultivation of which is a specialty of Brussels and its suburbs.

There are two species of chicory grown in Belgium. The wild chicory (*Chichorium intybus*) is cultivated in the neighborhood of Roulers, Thourout, and one or two other localities, in close proximity to the chicory manufactories, where the roots of the plants are parched, ground, and sold loose or in half-pound packages, to be used in connection with coffee, especially by the working classes.

The white chicory was originally brought to Belgium from India, and the principal center of cultivation is in the immediate neighborhood of Brussels, especially in Schaerbeek, Evere, and Woluwe. The root of this plant is of inferior quality and is consequently used as cattle feed.

The growing of this essentially winter vegetable requires great care, trouble, and hard work, beginning early in April, when the seed is sown. As soon as the plants are an inch or two high they are carefully thinned out by hand, leaving the most vigorous undisturbed a given distance apart. In September and October, when the plants are in full maturity and the leaves very long, they are taken out of the ground and the leaves carefully cut off about two inches from the root. Trenches are prepared, and the plants are disposed in them in three layers, each layer being covered by 10 inches of earth and from 12 to 14 inches of horse manure. This manure produces an artificial heat, which causes the chicory to sprout, and the earth being compactly pressed upon the plants, the leaves adhere closely together, and as no sunlight penetrates the covering, the plants are bleached white and present a most attractive and appetizing appearance when removed for consumption. This is done according to the demands of the market. The vegetable is available all the year round, but the most active demand is in the months of January, February, and March, during the scarcity of other garden vegetables.

The above-described method of bleaching chicory has existed since the commencement of the cultivation of this popular vegetable, but much complaint is heard concerning it, principally on account of the germs contained in the horse manure, which is likely to render the vegetable unwholesome and unfit for consumption, and also on account of the danger of a sudden frost, which, by lowering the temperature of the manure covering, checks the growth of the plants and correspondingly affects the selling price. To combat these inconveniences the cultivators of chicory at Schaerbeek, one of the most important suburbs of Brussels, have for some time been experimenting—heating the layers of plants by the system of thermo-siphons. The system has the advantage of giving a regular, constant heat, and greatly reduces the manual labor connected with the cultivation.

Although an immense quantity of chicory is consumed in Belgium, the yield is sufficient to supply Paris with large quantities, where it is largely used in the hospitals of that city. The average wholesale selling price in Belgium is 7 cents per kilogramme (2.20 pounds), and in Paris from 14 to 16 cents. To perform all the different operations connected with chicory growing demands hard work and constant attention. The most dangerous part of the work is the loading and transportation of manure, which has to be done before 8 o'clock in the morning. The great differences in the temperature of the cavalry and other stables, where the horse manure is obtained, and the temperature of the outside cold and chilly morning air frequently results fatally to the men employed in this work.—Geo. W. Roosevelt, Consul, Brussels, Belgium.

Modern industry, by improving and multiplying its methods of action, has increased the danger for the operative, who depends for his livelihood on his daily labor. Machinery, to-day replacing and decupling human force, constitutes not only an admirable source of production, but also a terrible source of danger. An industrial establishment, as has been said correctly, is a battlefield, having, like war, its victims, some mortally attacked, others more or less grievously wounded, and for a longer or shorter period rendered incapable of providing for their personal needs. The legislator should not be indifferent to these misfortunes. One of his prime duties is to prevent or mitigate their effects as far as possible. M. Riard says these things in La Revue Technique.

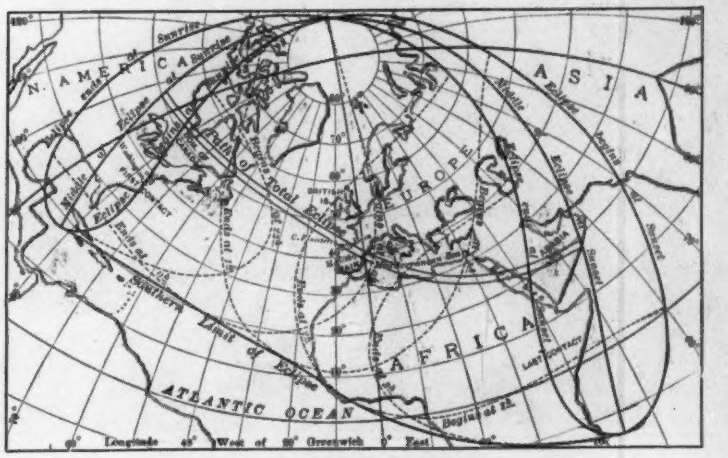
THE UNITED STATES NAVAL OBSERVATORY ECLIPSE EXPEDITION.

BY C. H. CLAUDY.

An eclipse of the sun, visible in part to the greater area of North America, Europe, Africa, and Asia, will take place on August 30, 1905. The eclipse is total to parts of Canada, Atlantic Ocean, Spain, the Mediterranean Sea, Africa, the Red Sea, and Arabia. To observe the phenomena attendant upon the total eclipse of the sun, the United States naval observatory is equipping three expeditions to go to Spain and Africa.

The exact locality in which the three expeditions will locate has not been absolutely determined, but it is probable that the two parties who go to Spain will station themselves on the central line of the eclipse near Burgos, and near Sagunto. The African party will in all probability locate at Sauk Ahauras, Africa.

The equipment of the parties has been a matter of deep thought and much work to the observatory officials. Experiences in the past have proved that, other things being equal, the best equipment yields the best results, and that carelessness in equipment means an irreparable loss. For the time of totality is very short, and all the work which is done on the total eclipse phenomena must be accomplished, in this instance, within the limits of three minutes and forty seconds at Burgos, two minutes and twenty-nine seconds at Sagunto, and three minutes and thirty-four seconds at Sauk Ahauras. Naturally, the apparatus must be as perfect as ingenuity and skill can make it, and the men operating it drilled in every movement, in order that everything may go off without a hitch, and that the maximum amount of photographs be taken in the allotted time. Unlike the eclipse expeditions of several years back, almost all the work done, both telescopic and spectroscopic, is now accomplished with the camera as the most important part of the outfit. Photographs taken during the hurried work can be studied at leisure and are at once more accurate and more reliable than visual observations and the most painstaking drawings. Of course, the camera cannot record the colors, but that is about its only limit.



PATH OF THE ECLIPSE OF AUGUST 30, 1905.

Taking up each party in turn, the equipment is as follows:

For Party No. 1, which will go to Burgos, there is provided, first a stationary camera provided with a 40-foot focus lens of 5 inches diameter, which produces the image of the sun on a 14 x 17 plate. A more detailed description of this instrument will follow. Next is a polar axis, on which is mounted a camera with an 8½-inch lens of 12 feet focus, using 11 x 14-inch plates, and a 6-inch Dallmeyer lens of 36 inches focus, both of which are for photographing the extensions of the corona. This polar axis will also carry a spectroscopic camera. The stationary camera uses a cœlostat (a device in which a mirror, run by clockwork, keeps an image of the sun in one position as the earth moves under it), and upon the other end of the shaft carrying the mirror will be a plane-grating spectroscope, with a 5-inch aperture and 72-inch focus lens, taking photographs on plates 14 x 1½ inches. It is expected to make at least twelve exposures with this instrument during totality. Dr. S. A. Mitchell, of Columbia University, New York city, will be in charge of the spectroscopic work at this station, and besides using the instrument just described, will have, in addition, a cœlostat used on one of the old transit-of-Venus expeditions to which will be attached a parabolic grating spectroscope.

Station No. 2, near Valencia, Spain, will have the giant camera of the three expeditions, which is illustrated herewith. It is 65 feet long and has a lens triple achromatic, made by Brashear after curves computed by Prof. C. S. Hastings, of Yale. The lens is 7½ inches in diameter and produces an image of the sun 7 inches in diameter. Next in the equipment of this station comes a polar axis, on which is mounted a camera provided with a 6-inch lens, of 104-inch focus, and using 8 x 10 plates. This camera is provided with a color screen, and, like the cameras on the various polar axes, is for work on the outer corona. On this axis will be a 21-foot concave grating spectroscope, used direct.

The third party, in Africa, will be provided with a camera containing a lens of 5 inches diameter and 40 feet focus, a polar axis, and on it a camera with a lens 9.6 inches in diameter and of 14-feet focus, for 11 x 14 plates, and a 10-foot spectrograph pointed directly at the sun. This party also will have a transit-of-Venus cœlostat and a new instrument, termed the chronospectrograph, which will give a continuous spectrum with indicated time, in seconds, during the time of totality. Prof. L. E. Jewell, of Johns Hopkins University, will be in charge of the spectroscopic work of this party.

If the illustration of the big camera herewith printed is examined, it will be seen that it is composed of a series of wooden frames, ending in a little house. This house is knock-down and portable, and contains a double door, so that members of the party may enter and leave it without admitting light. It has no windows, but the roof lifts up to allow ventilation and light when desired. It was photographed while set up in the Observatory grounds, where it was being tested. The thoughtful reader will at once inquire why, if the frames are made at all, they are not covered? The answer lies in the fact that for testing the action of the cœlostat and the working of the plate holder, etc., experimental photographs are taken with a focal plane shutter, of the sun as it is. The exposure is less than a thousandth part of a second, and what little light can get through the small opening of the two covered sections in that time is immaterial. When the sun is in eclipse, however, the exposure will be much greater, possibly thirty seconds. Hence the need of an instrument which will keep the sun still, in reference to the plate, and the covering, to exclude every bit of extraneous light.

The cœlostat on this instrument is one which the Observatory has had and used before. The cœlostats for the other two long-focus cameras, however, are new. They were designed by Mr. W. W. Dinwiddie of the Observatory staff, and made by William Gaertner, of Chicago. They are at once simpler, lighter, and much less expensive than any similar instruments ever carried on an eclipse expedition. Another illustration shows one of these cœlostats being tested by its designer. The cœlostat is simply a polar axis, a means for revolving it in the opposite direction to the earth's movement at a speed equal to that of the earth about its axis, and a mirror on one end of this axis. When the mirror is so adjusted that the rays of the sun fall in any one particular spot, and the clockwork set in motion, the rays of the sun continue to fall on that selected spot, for as fast as the earth carries the spot away from the place of reflection, the mirror alters its position so that the rays follow the spot. In this case, of course, the spot is the target placed over the sensitive plate in the end of the camera.

The polar axes are, as seen in the illustrations, simply triangular frames, which support a trussed structure forming the axis. This trussed structure has attached to it another trussed structure, which, when covered, and provided with a lens and plate holder, forms a camera, adapted to follow the sun as the earth turns upon its axis. These cameras, having a focus of from 12 to 15 feet, yield a much smaller image of the sun than do the huge stationary cameras of from 40 to 65 feet focal length. The smaller cameras, therefore, are adapted to picture the eclipse and all the coronal prominences and streamers. The larger cameras are devised to make large pictures of the sun and devote their particular attention altogether to the phenomena in the immediate vicinity of the sun. The polar axes also carry the spectroscopic apparatus, for making spectrographic photographs. The means by which the clock motion is transmitted to these polar axes is extremely interesting, as being so simple. As seen in the illustration, the clockwork, which is in the metal case in the foreground, is connected to the instrument by a horizontal shaft. This shaft meshes, by means of cogs, with a drum, around which passes a small wire cord. This cord is supported, on the right, by an idle drum, and on each end of the cord is a weight. As the shaft turns, the cord moves, and when, by means of a clamp, the truss rod which leads to the polar axis is connected to the cord, the polar axis will move in an opposite direction to the cord. The clamp, which connects the connecting rod with the cord, allows the polar axis to be set, within sufficient limits for the short period wanted for photographing the eclipse, at any desired position. The whole thing has the merit of simplicity and strength, and can stand weather,

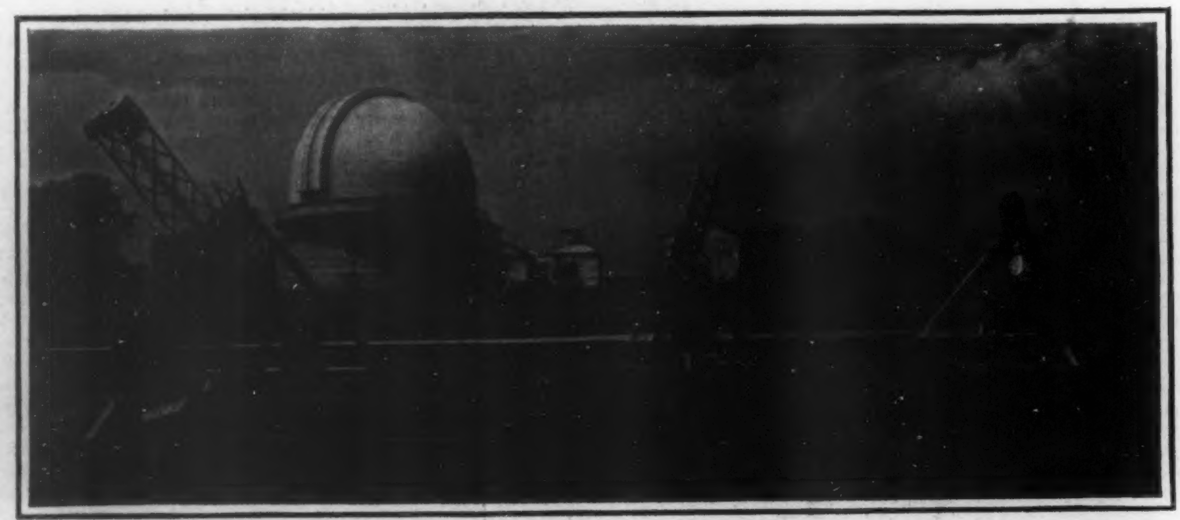
while at the same time it is, for all intents and purposes, absolutely accurate. Even supposing there exists a slight error in the rate of the clock, which should escape the vigilant tests made for such aberrations, the error would be small for a day's journey of the sun across the sky, and for a period of a few seconds would be *nil*. Nevertheless, no errors not known, and so to be accounted for, will exist if careful testing, both before shipment and after it is set up on the ground at the eclipse station, can help it. The illustration showing the three polar axes, in different stages of completion, also shows an observer testing, with a small telescope and micrometer, for periodic errors in the clockwork. Many observations are taken of the actual rate of the clock, and the mean compared with the known rate of the earth's motion. The error, if error there is, is obviously easily detected.

It will be noticed that these polar axes, as well as the big cameras, are all of such construction that they may be taken to pieces and put together easily. It is necessary to ship all the instruments very carefully, and to have them packed with the greatest nicety. To this end everything comes to pieces and is packed in boxes specially made for the purpose; and to guard against possible damage, every part of the delicate instruments, such as clockwork, axes, lenses, shutters, etc., is wedged into specially built compartments in the boxes.

Besides the instruments mentioned, each party will have a large portable transit, for determining latitude and longitude and for setting the instruments, and distributed among the parties are five 5-inch portable equatorial telescopes, for visual observations.

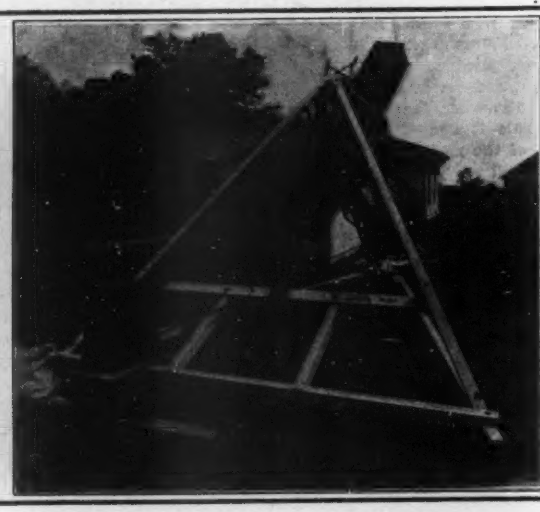
As far as determined, the personnel of the parties is as follows, all under the general direction of Admiral Chester, who is at the head of the Observatory:

First party: Prof. W. S. Eichelberger, Mr. E. I. Yowell, Dr. S. A. Mitchell. Second party: Prof. F. B. Littell, Mr. George A. Hill, Mr. G. H. Peters, Commander Hayden in charge. Third party: W. W. Dinwiddie, Prof. L. E. Jewell, Capt. Norris in charge.

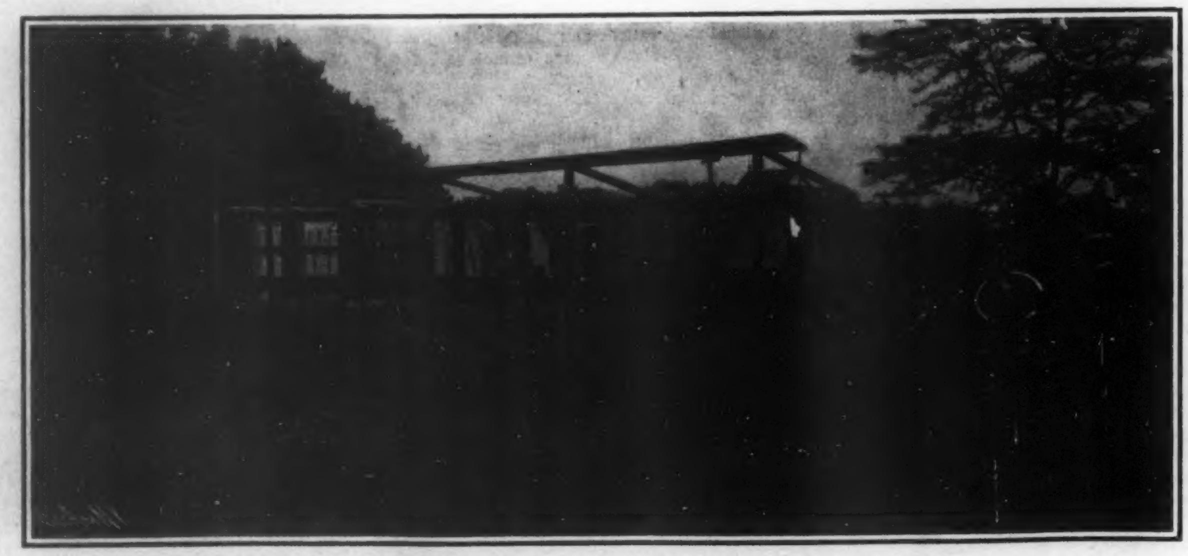


The Three Polar Axes in Different Stages of Completion, Set up for Clock Tests in the Naval Observatory Grounds.

Mr. Dinwiddie Examining His Coelostat. This Instrument is One of Two Built for the Coming Eclipse.



One of the Polar Axes with Camera Mounted and Temporarily Covered for Testing.



A Sixty-Five Foot Camera Erected for Tests in the Naval Obervatory Grounds.

THE UNITED STATES NAVAL OBSERVATORY ECLIPSE EXPEDITION.

The instruments have been largely made at the Observatory, and many of them were designed by Mr. Dinwiddie. He is responsible for the two new cœlostats, the three portable dark-rooms, the three portable houses which are the ends of the big cameras, the three polar axes, and the chronospectrograph, besides the 10-foot concave grating spectrograph. The parties and their equipment will start from Alexandria, Va., on the U. S. N. collier "Cæsar," about June 15 or 20. Arriving at their stations, the instruments will be immediately set up and tested, and when in perfect running order the members of the party will drill daily until all are letter-perfect in the actions that each is to perform. So much attention is paid to the details of the drilling, in order to have every man perfect, that dummy glass-plates, for the big cameras, are carried, with ground edges to prevent accidents. These big plates are handled naked, and as everything depends upon getting them into the holder in the portable house, exposed, out of the holder, and put away, and another one in place, with the utmost dispatch, the importance of this provision is at once seen. As the entire party is divided into three stations, there seems to be a good chance of good results. The only thing to fear in the weather line is thunder-storms, and should three thunder-storms occur at the three different stations at the time of the eclipse, the laws of chance would stand in serious need of revision. Inasmuch as the equipment is superior to any heretofore carried on such an expedition, and long experience in such work is behind the various members of the parties, much is looked for in the way of new data concerning the many only slightly understood phenomena of a solar eclipse. No eclipse has ever been photographed with the thoroughness with which this one will be; naturally superior pictures are looked for. Beside the expedition of the Naval Observatory, almost every prominent astronomical observatory in the world will send out parties. Many private expeditions are also bound for Spain and Africa to view the eclipse.

A recent invention renders the barrels of both firearms and pneumatic guns thoroughly rust-proof, durable, and cleanable by the use of a rifled glass lining. The gun barrel comprises an outer shell of usual gun metal, which may be cylindrical or octagonal or any other shape. The bore of the barrel at the rear end is increased in diameter, to form the firing chamber, in which the shell of the cartridge is received, and from the forward end of this chamber to the nozzle of the barrel is a lining of glass, which has any desired thickness and the requisite toughness. The position of the glass lining is such that the products of combustion do not come in contact with any metal surface but only with the glass. The glass is rifled throughout its length, so as to give the projectile its proper rotation. Some expert opinion may question whether the process can be of more than speculative value, yet the invention is made attractive at least by its originality.

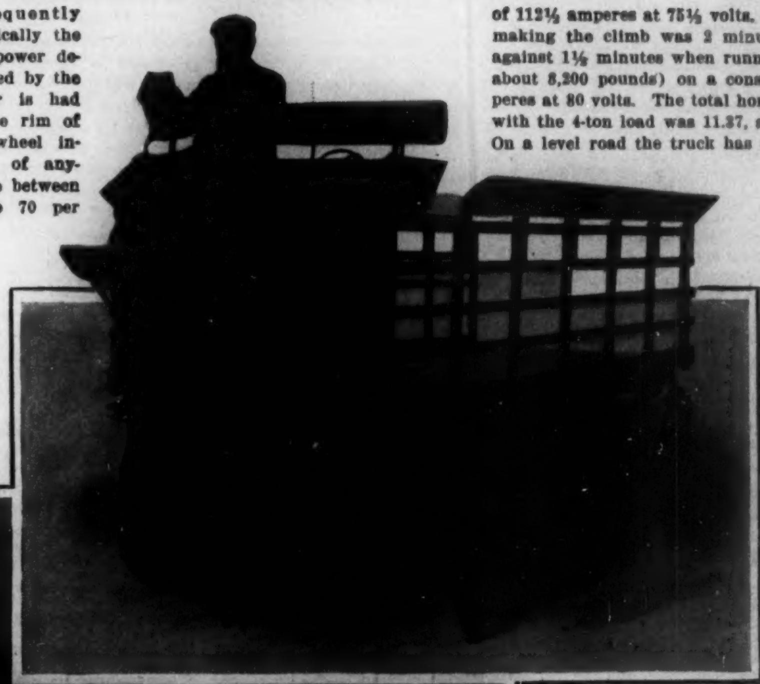
NEW TYPE OF ELECTRIC TRUCK.

The electric truck shown in the accompanying illustrations is fitted with a single electric motor within each wheel. The motor is a high-speed one of the bi-polar series type and is normally rated at 2 horse-power. It rotates at a speed of 1,400 R. P. M., which is reduced in the ratio of 25 to 1 through single reduction gearing of novel construction. With this reduction, the motors drive the truck at about 6 miles an hour.

The great traction and control secured by a four-wheel drive is shown by the photo of the machine dropping off the curb slowly and closing a watch case lid without breaking it. The truck can be backed against a 12-inch curb and then made to climb it from rest. This feat was done with it recently in the presence of the writer, and it furnished a striking demonstration of the tractive power of the truck. In doing this feat, the ammeter needle jumped only to the 150 point for a brief instant, which corresponds to a 100 per cent overload of the motors—an overload which is never exceeded. So effective is the traction that the truck was able to pull stalled horse-drawn trucks out of the snow last winter, even when equipped with steel tires.

The appearance of the interior of the truck wheel and the manner in which it is driven by the pinions on the armature shaft of the motor are made apparent by a glance at the views showing the wheel open and looking down upon it, with rim removed.

As can be readily seen, the frame that carries the field magnets terminates at one end in a hollow spindle which carries a roller bearing for the wheel and through which pass the wires for conveying current to the motor. The armature is placed horizontally and practically parallel with the plane of the wheel. It carries a bevel pinion on each end of its shaft. These two pinions mesh respectively with two gear rings which face each other and are attached to the hub of the wheel. The thrust of one pinion against the opposing ring is counterbalanced by that of the other pinion against the ring that faces it, so that a couple is formed, with the result that there is little or no thrust upon the wheel motor bearings. So much is the friction reduced by this arrangement, that the transmission loss from motor to wheel with a speed reduction of 14 to 1 has been found to be only 1 per cent with as high as a 16 per cent overload, while in the truck we illustrate it does not exceed 3 per cent. Consequently practically the full power developed by the motor is had at the rim of the wheel instead of anywhere between 50 to 70 per cent of this power, as is the case with the usual spur gear, double reduction transmissions usually employed. In order to allow for any wear and so as to always be certain that the application of power to the wheel is equally divided between the two pinions, each motor is fitted with an equalizing device that accomplishes this result.



Turning the Truck with all Four Wheels Parallel.

Turning Position with the Front and Rear Wheels Following the Arc of a Circle.

NEW TYPE OF ELECTRIC TRUCK.

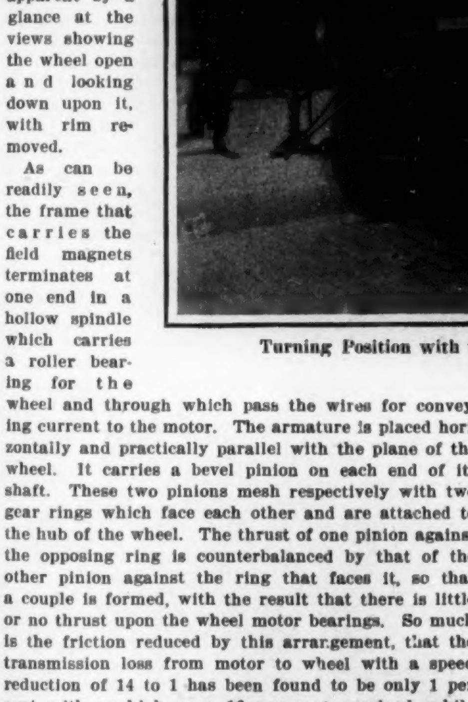
The controller used on the truck is of the usual trolley-car type. The diagrams show the connections made at the motors and controller to obtain the five speeds in either direction. In starting, each pair of motors is connected in series through half of the battery. For the second speed the armatures are kept in series and the fields are placed in parallel. On the third speed the motors are in parallel on half the battery. The fourth speed finds the fields in parallel and armatures in series on the whole battery of 42 cells, while on the fifth speed the motors are in parallel on the whole battery. The fourth speed gives the maximum torque and is the regular running speed.

On account of the great saving in transmission of power to the wheel through the single reduction couple-action gear, the 3 to 5-ton truck shown, whose weight complete is 7,700 pounds, will run on some 30 per cent less current than the ordinary truck of the same size. The result is that the battery and motors will last much longer than is usually the case, as they are never seriously overloaded. Under regular service conditions, about 3,000 miles can be got out of the battery before it will need cleaning. An examination of the motors by the editor of this journal showed them to be in very good condition, there being, apparently, no trouble from burning of the commutators due to jumping of the brushes from the excessive vibrations the motors would be expected to receive in the wheels. The tension on the brush holder springs, too, was very light.

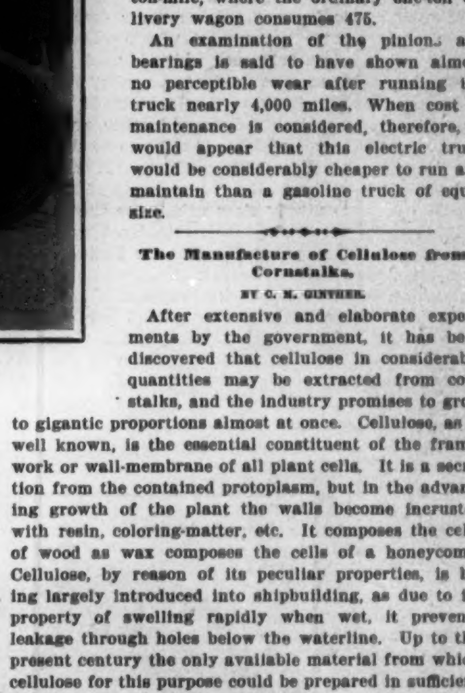
Some tests made recently in New York city show the economy of the new truck under severe hill-climbing conditions. The hill at Ninety-first Street and Lexington Avenue, which is paved with cobblestone and has a 15 per cent grade, was mounted with the controller on the fourth speed with a current consumption of 112½ amperes at 75½ volts. The time taken in making the climb was 2 minutes 40 seconds, as against 1½ minutes when running empty (weight about 8,200 pounds) on a consumption of 68 amperes at 80 volts. The total horse-power developed with the 4-ton load was 11.37, and without it 7.15. On a level road the truck has carried 3½ tons at about 5½ miles an hour (fourth speed) on but 42½ amperes at 80 to 84 volts (5½ horse-power). The current and voltage used in the hill-climbing test were accurately measured by two separate sets of recently calibrated Weston instruments, so the observations are probably quite accurate. An ordinary two-motor truck, although capable of ascending a 15 per cent grade nearly twice as fast, consumes about three times as much current, and the heavy discharge rate soon ruins the battery.

The truck uses about 200 watts per ton-mile, where the ordinary one-ton delivery wagon consumes 475.

An examination of the pinions and bearings is said to have shown almost no perceptible wear after running the truck nearly 4,000 miles. When cost of maintenance is considered, therefore, it would appear that this electric truck would be considerably cheaper to run and maintain than a gasoline truck of equal size.



Type of Wheel Used for Light Vehicles.



Closing the Lid of a Watch without Breaking the Crystal.

Perfect Motor Control.

The Manufacture of Cellulose from Cornstalks.

BY C. M. GINTHER.

After extensive and elaborate experiments by the government, it has been discovered that cellulose in considerable quantities may be extracted from corn stalks, and the industry promises to grow to gigantic proportions almost at once. Cellulose, as is well known, is the essential constituent of the framework or wall-membrane of all plant cells. It is a secretion from the contained protoplasm, but in the advancing growth of the plant the walls become incrusted with resin, coloring-matter, etc. It composes the cells of wood as wax composes the cells of a honeycomb. Cellulose, by reason of its peculiar properties, is being largely introduced into shipbuilding, as due to its property of swelling rapidly when wet, it prevents leakage through holes below the waterline. Up to the present century the only available material from which cellulose for this purpose could be prepared in sufficient quantities was the cocoanut shell. The ground fiber of the cocoanut shell with a small percentage of the original fiber constituted the cellulose of commerce.

This wonderful material possesses the property of swelling rapidly when wet and is very light. It is practically free from danger of fire, burning very slowly, and with great difficulty when compressed. In France experiments made by firing a 10-inch shot through a mattress of cellulose demonstrated that the fibers came together and swelled so rapidly that only three gallons of water passed through the aperture, and in a short time the hole was closed entirely. Cellulose was first used in shipbuilding in 1884, but it obtained favor so rapidly that in 1890 the French introduced it into some forty vessels of their navy, and in the same year its use was ordered as a means of protection in the construction of ships in Russia, Holland, Japan and Greece, as well as in the American navy. It was soon demonstrated that the supply of cocoanuts in the world was far too small to furnish the cellulose demanded for warships alone, and search was made for a more plentiful and cheaper material. The Cramp Shipbuilding Company spent years in trying to find a substance that would serve the same purpose, and at last discovered it in such abundance that the question of supply was forever settled. Cornstalk, which the farmer has been throwing away as waste, was found to contain in its pith the very best material in the world for making cellulose. Almost immediately arrangements were made to build large factories in different parts of the country where corn was the staple crop. Three such factories have already been established in this country, and two in Europe. This corn pith, for ages considered worthless, has been found to contain not only cellulose to be used for protecting ironclad vessels, and preventing them from sinking in case their shell is punctured below the waterline, but also from it can be made smokeless powder, dynamite, and other high explosives, fine art paper, varnish, kodak films, car-box packing, filler, waterproof cloth, linoleum, imitation silk, patent leather finish, face powder, silicate packing, and a hundred other by-products the despised cornstalk was never dreamed to contain. The outer lining, that which contains the pith, is made into a substance which is used to adulterate flour, also as a cattle food, a poultry fattener, and egg producer. Some of it will be made up into candy, part into coloring dyes, and other properties have been discovered which make it one of the most useful substances the earth produces. It will add thousands of dollars to the crop receipts of farmers, which is almost entirely clear gain, since the product utilized is only that which was considered worthless.

The annual average corn area of the United States is not far from 80,000,000 acres. Each acre yields on an average about 4,000 pounds of cornstalks, or a total of 160,000,000 tons. Of this weight 85 per cent, or 136,000,000 tons, has value as feed, but not over 10 per cent of it is actually fed. The other 15 per cent of the total weight, or 24,000,000 tons, is the pith of the stalk, which has been a total loss, or even worse, since it required labor to dispose of it. One company pays $3 a ton for the stalks, and produces a material which is worth 17 cents a pound, or $340 a ton. It has been figured that every ton of cornstalks in the country could be so handled that it would increase the value of each corn crop $480,000,000 annually.

The "Kearsarge," the "Kentucky," the "Indiana," the "Illinois," and all the new war vessels that this country and all other nations are putting on the seas, have a double armament around the waterline, underneath the heavy Harveyized steel plates. It is composed of cellulose from corn pith, and is six feet in thickness. In the late Chinese-Japanese war the value of cellulose jackets under the steel was demonstrated in a very startling manner. In one battle two Chinese men-of-war were sunk by Japanese balls penetrating below the waterline and allowing the water to rush in and sink the ships; in the same battle one of the largest Japanese ships was struck below the waterline. The shot passed through a jacket of cellulose, which instantly swelled upon the water striking it, and closed the hole entirely. It is said that not a drop of water penetrated into the hold of the vessel. The ship continued in the fight, and afterward leisurely proceeded to dock, where the injury was repaired. Corn pith will hold twenty times its own weight of water, absorbing it like a sponge, and expanding over sixteen times its compressed bulk. These properties of swelling and absorbing water make it superior to any other substance for a like purpose known. The process of manufacture is elaborate. The stalks are cut, broken, and mashed, and then by a series of elevators and suction pipes, the stalks are screened and separated and disposed into various receptacles and treated chemically. Stalks of one crop are stacked and stored and permitted to sweat and dry over winter. After six or eight months they are thoroughly dry and ready to be taken into the factory. They are now cut into pieces one inch in length and then shaken, to cause the pith to fall out. After the stalks are cut they are not touched by the workmen again, all the rest of the process of manufacture being accomplished by automatic machinery. The pith is finally chemically treated, compressed to one-sixteenth in bulk, and made into blocks six inches square. The chemical treatment makes them fire-proof. The government into whose ships the cellulose in process of manufacture is to be placed always has a representative present to inspect the process of manufacture and to subject the material to various tests to insure its quality. Among other tests, each block of cellulose is subjected to a heat of one thousand degrees, and if it does more than merely sear, it is rejected. The blocks are then packed into waterproof boxes and shipped.

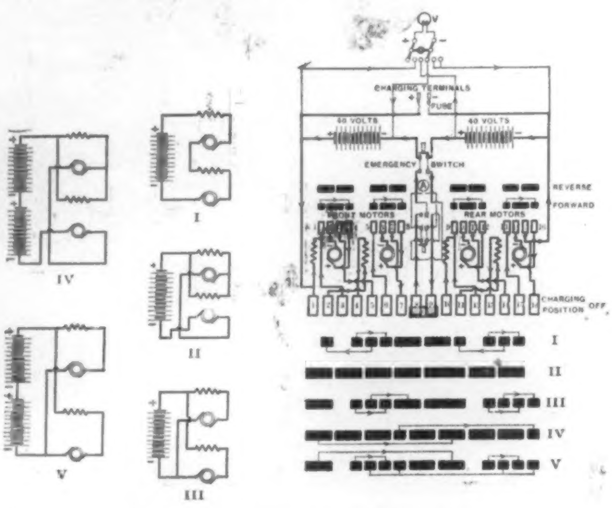


Diagram of the Controller Connections.

Duc d'Orleans Polar Expedition.

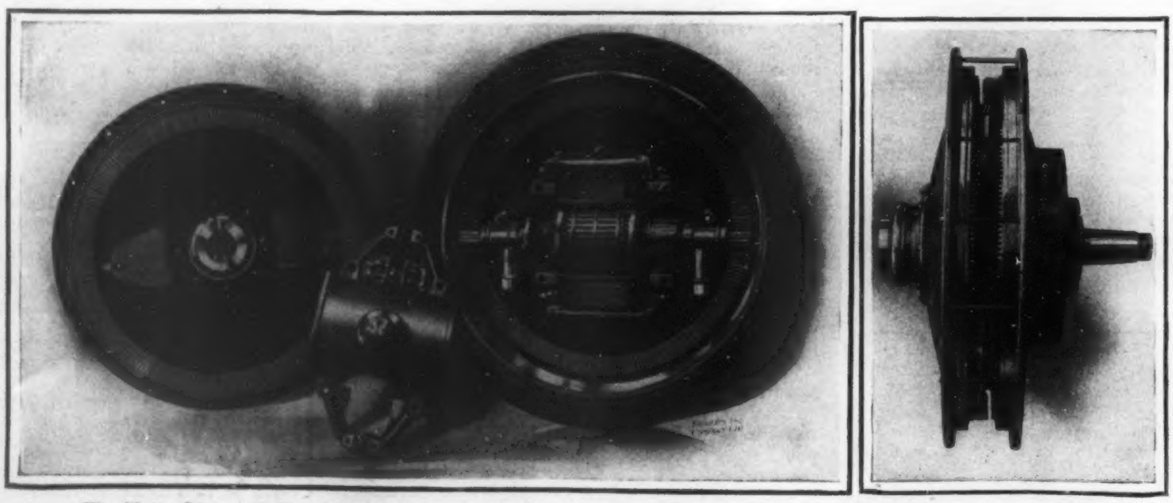
The steamer Belgica with the Duc d'Orleans on board sailed May 24 for Tromsoe on her way to the Arctic regions, where it is said the duke will attempt to communicate with the Ziegler expedition, headed by Mr. Anthony Fiala, of Brooklyn, N. Y.

The whaling steamer Belgica, recently purchased and provisioned for two years by the Duc d'Orleans, made a voyage to the Antarctic regions with a Belgian expedition in 1897, returning in 1899. The captain, the crew, and the scientific staff have each of them had experience in Arctic exploration. The duke will take charge of the naturalists' department.

Electrically-Operated Switches and Signals.

At the London terminus of the London and North-Western Railroad, an installation for the operation of the semaphores, switches, and crossovers by electric power is being carried out. The system adopted is the invention of one of the engineers to the railroad. The power is to be drawn from a generating station capable of supplying 700 horse-power. The heavy traffic at this terminus requires incessant backing of arrival trains into sidetracks, and the rapidity with which the movements of the switches and signals controlling these operations has to be performed, rendered the manual method impracticable. The operation of the electrical system is as follows: When the signalman moves a lever controlling a crossover or signal, the action becomes locked halfway; the movement transmits an electric current to the switch, and a small electric motor draws it over and then becomes disengaged. Simultaneously, a current returns to the cabin, and releases the locked lever, which can then be fully drawn over, a movement which assures the signalman that the crossover has been completely moved and is ready for the approaching train. The half-way stoppage of a lever on being first moved, which remains so until the electric current drawing together the crossover returns to notify that they have finally closed and thereupon releases the particular lever, is a protection against the signal lever being moved until the connection is complete. Any defect in the crossover, or any obstruction, such as earth, pieces of wood or other substance intercepting their proper closing, keeps the connecting lever in the cabin locked half-way and the signal at danger until the fault is rectified. A further safeguard is found in the action of the levers, which operate the signals governing the crossover so moved. The signal lever can be fully pulled over at once, and the signal is thereby instantly moved to the "all-right position," an electric current again having been sent and energized a magnet operating the signal. This current, however, does not go direct, but passes through a switch which is opened and closed by the crossovers, and if these have not moved correctly or are not actually bolted, the current to the signal is stopped, and the latter remains at danger. After the train has passed, the lever working the signal is moved back, and the signal arm, by gravity, instantly returns to the danger position. If it does not, the signalman instantly knows it, as a further check is provided by the lever then becoming locked halfway. It is only by the complete movement of the lever that the operator knows the signal has reverted to danger.

The object of the water-tube boiler is to reduce weights, give greater safety against explosion, greater rapidity of raising steam, and an increase of economy in the generation of steam. The various makes of water-tube boilers are too numerous to mention, but they divide themselves into two broad, general classes—those with straight tubes of large diameter, say four inches; and those with curved tubes of small diameter, from an inch to an inch and a half. Probably no single boiler possesses all the merits which a perfect water-tube boiler should have, and in nearly every case the attempt to secure certain advantages brings attendant disadvantages, and *vice versa*. The large straight-tube boilers are not so light as the ones with small tubes; and it is more difficult to secure adequate economy, which is dependent largely upon skillful baffling. They do not permit of such rapid raising of steam from cold water as the smaller tube boilers, because, like the Scotch boiler, they carry a large reserve supply of water in the boiler after the manner of the Babcock & Wilcox boiler. On the other hand, they permit the replacement of a defective tube and of the cleaning of a tube much more readily than the tubes which are bent. Likewise it is only necesary to carry one size of spare tubes, while the bent tube boilers require several.



The Motor Dissected, Showing the Manner in Which the Power is Applied to Both Walls of the Inclosed Wheel.

NEW TYPE OF ELECTRIC TRUCK.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

OIL-PRESS MAT.—R. F. WERK, New Orleans, La. The object in view in the present invention is the production of a hair mat or cloth for use in oil-presses which is capable of a certain amount of pliability in a longitudinal direction, whereby the formation of a cake of the compressed material is facilitated. The parts are arranged to afford protection to weft-threads, to reduce tendency of selvage to unravel, and to enable the mat to be folded longitudinally at any line without breaking or giving way in threads or strands. This inventor has secured another patent on an oil-press mat. It is made of animal hair by weaving together threads or strands in a well-known manner; and the distinguishing feature resides in warp-threads made of soft hair. This overcomes the great difficulty, a liability to unravel. The desired strength and durability of the mat are secured by use of hard, stiff, and coarse hair in the production of weft-threads. Both improvements are divisions of earlier applications for Letters Patent filed by Mr. Werk.

LATCH AND LOCK.—C. A. PRESCOTT, Victoria, Canada. The improvement refers to insertible or mortise locks adapted to serve the dual purpose of a door lock and latch, and has for its objects to provide novel details of construction for a combined door lock and latch which are simple and inexpensive and that adapt the same for convenient application upon a door without requiring a large mortise to be made therein.

FOUNTAIN-PEN.—F. E. SHAW, Evart, Mich. The piston being in inward position, the pen end of reservoir is immersed in ink and piston is drawn outwardly by the finger-piece of its rod, a protection contacting with inner side to move it. This sucks the ink into the reservoir. The rod is turned until its projection strikes the portion of contact member adjacent to the opening and is then thrust inwardly until its enlargement fills the opening. It is now ready for use. The charge exhausted, piston is returned to active position by drawing out piston-rod until the inner extremity of projection is outside the head. Then the projection is turned into coaction with contact member at the side opposite the opening, when the piston will be held so as to be forced inwardly.

SECRET DOUBLE SAFETY-POCKET.—C. H. SCOTT, New York, N. Y. The objects of the invention are to provide means for holding valuables or articles of any kind, effectually concealing the receptacle thereof by so constructing it as to permit it to be comfortably worn beneath the clothing, and to construct an efficient holding means for securing it to the person or garments, especially so as to enable it to serve the additional function of supporting hose or other garments.

SENSITIVE PHOTOGRAPHIC-PRINTING PAPER.—E. C. MORGAN, Kew Foot Road, Richmond, Surrey, England. The improvement in this case pertains to sensitized photographic-printing papers, plates, and films, more especially of the "self-toning" class, the invention consisting, essentially, in the employment as vehicle for the light-sensitive salts in the emulsion with which the support (paper, glass, celluloid, etc.) is coated of agar-agar and arrowroot or other starch in substitution for gelatin or collodion. When paper is used as the support, it may be pure raw paper or paper with baryta-coated surface.

HORSE-FLY TRAP.—J. MCCONNELL, Blaine, Wash. In the present patent the invention has reference to fly-traps; and the object is to produce a device of this character which is intended especially to be used to catch horse-flies, deer-flies, and other insects which torment horses. The device may be attached to any suitable point, a very desirable place being on a trace opposite to the middle of the body of a horse.

NON-REFILLABLE BOTTLE.—J. E. MOSEMAN, Donaldsonville, La. The improvement belongs in that general class of bottles which are provided with attachments adapted to prevent refilling after discharge of original contents, and it is more particularly an improvement in that special class in which the attachment comprises a stopper permanently secured in a bottle-neck and provided with a passage having a valve that will permit discharge but prevent entrance of liquid.

INFUSION DEVICE.—MARY H. FRENCH, New York, N. Y. This invention relates to tea-making devices; and its object is to provide a new infusion device for making infusions of tea and like substances in a very simple and convenient manner and to a strength according to the desires of those for whom the infusion is intended, the device also serving for holding sugar and like substances used for sweetening beverages.

SHAVING-BRUSH HANDLE.—J. L. ERSKINE, New York, N. Y. The purpose in this improvement is to provide a construction of one-piece handle for shaving brushes in which all the advantages of a two-piece or multiple-piece handle are obtained and whereby at the same time the cost of manufacture is not materially increased over the ordinary one-piece handle.

DRAFTING INSTRUMENT.—A. A. ALLEN, Ortonville, Minn. In this case the object of the invention is to provide a new and improved drafting instrument more especially designed for the use of tinners, plumbers, and other mechanics in laying out the blanks for forming elbows, T's, and other articles of sheet-metal and like material.

Household Utilities.

HOLDER FOR BROOMS AND BRUSHES.—J. HUTCHINSON, Belleville, Ill. This article of manufacture comprises an improved broom-holder formed of a single piece of wire, one end of which is screw-threaded and projects laterally, and a U-shaped body portion composed of opposite jaws formed by loops of the wire, the latter extending across diagonally from one jaw or loop to the other.

Railways and Their Accessories.

AIR-BRAKE SYSTEM.—J. E. SHAW, Council Grove, Kan. The regulation by the engineer of the exhaust and the establishing of communication between the locomotive-cab and the train, in this invention, is secured without in any way impairing the efficiency of the brake systems as they are used at present. On the contrary, they are made more effective by the maintenance of control of the brakes under all conditions.

MEANS FOR PREVENTING RAILS OF RAILWAY-TRACKS FROM CREEPING.—J. R. LEIGHTY, Cumberland, Md. This device serves as a stop to prevent any creeping of the rail—that is to say, when the device is applied it then constitutes a stop by reason of its construction and arrangement irrespective or in advance of the canting of the nut on the bolt which occurs by actual creeping of the rail and only serves to increase the gripping action of the device. The thrust of the tie in case of creeping of the rail is on the end of the main plate proper and not on the wings thereof.

FRUIT, PRODUCE, AND REFRIGERATOR CAR.—E. M. PHILLIPS, Castile, N. Y. The car is adapted for ventilation and for heating or refrigeration, as may be required. The most loss is from frost affecting cars at the bottom and ends. By the manipulation of the shutters and doors the car can be made much warmer in winter and cooler in summer; also, when it is desired to ship fruits, vegetables, etc., in warm weather (in bulk), the cold air from the ice-box will circulate beneath the floor, making the refrigerator much more effective than in the ordinary refrigerator-car. For this purpose it is necessary to close the door at the lower edge of one of the partitions.

CATTLE-GUARD.—J. COSTELLO, Glasgow, and W. D. MILLER, Saco, Mont. The object of the invention is to provide details of construction for a guard which effectively obstructs the passage of live stock along or across the rails and bed of a railroad. Means permit an animal to lift its feet and escape from the guard, the insecure footing and pain inflicted while avoiding serious injury so alarming the beast that it will retreat from the guard rather than traverse it in any direction.

RAILROAD SAFETY-ROD.—B. SARGENT, Rock Island, Ill. The improvement is in that class of bridles, ties, or couplings employed for preventing rails from spreading and which may be utilized independently of the ordinary ties upon which the rails are laid and spiked. Most efficient means are provided for preventing rails from spreading whereby perfect safety is obtained, and sleepers or ordinary ties supporting the rails are relieved of strain and wear incident to the usual means of fastening the rails thereto.

Pertaining to Recreation.

DEVICE FOR ATTACHING FISHING-LINES TO FLOATS OR SINKERS.—A. R. ROBERTSON, Pass Christian, Miss. This invention has for its purpose the provision of an attaching device of simple construction, by means of which a line may be quickly attached to and securely held in contact with a float or sinker, but permitting the float to be adjusted as desired, and that may be readily detached without removing hooks from the line or line from the rod.

Pertaining to Vehicles.

RUNNING-GEAR.—S. S. BREESE, Southampton, and C. L. LAURANCE, Bayshore, N. Y. This running gear is especially applicable for automobiles, but capable of general use. The objects are to provide a gear which will be lighter and of greater strength than those now known and also which will be flexible in all directions, but will operate without vertically deflecting the body of the vehicle.

STEERING-GEAR.—H. M. LOFTON, Atlanta, Ga. This steering-gear is especially intended for use on automobiles. Means are employed by which the inventor is able to avoid any and all of the accidents which result from a sudden jar acting upon the handle of the steering-gear, as the steering-wheel locks positively with the rack-bar, so the latter cannot move to any extent in either direction except when positively operated in such direction by the manipulation of the steering-wheel. By turning the wheel in either direction the bar may be moved in one direction or the other as desired.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of the paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 6956.—For manufacturers of stereopticon views.

For hoisting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 6957.—For manufacturers' works of an electric clock; also dials and pendulums.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 6958.—Wanted, address of parties handling thermit used for welding rails and cast iron; of appliances for using same.

Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 6959.—For manufacturers of electro-thermopiles.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 6960.—For manufacturers of paper tubes and tube boxes, cartons, etc.

Adding, multiplying and dividing machine, all in one. Felt & Tarrant Mfg. Co., Chicago.

Inquiry No. 6961.—For manufacturers of Geissler tubes.

Commercially pure nickel tube, manufactured by The Standard Welding Co., Cleveland, O.

Inquiry No. 6962.—For manufacturers of fountains, vases, urns, etc.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 6963.—For manufacturers of drop hammers run by compressed air.

I sell patents. To buy them on anything, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 6964.—For manufacturers of laundry supplies.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company, Foot of East 138th Street, New York.

Inquiry No. 6965.—For manufacturers of mica-cutting machines.

Gut strings for Lawn Tennis, Musical Instruments, and other purposes made by P. F. Turner, 46th Street and Packers Avenue, Chicago, Ill.

Inquiry No. 6966.—For manufacturers of lock umbrella stands, patented by A. M. Foote, February 7, 1899.

Sheet metal, any kind, cut, formed any shape. Die-making, wire forming, embossing, lettering, stamping, punching. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 6967.—For manufacturers of churn power which could be applied to the dash.

You can rent a well equipped private laboratory by day, week or month from Electrical Testing Laboratories. 548 East 80th Street, New York. Absolute privacy. Ask for terms and facilities.

Inquiry No. 6968.—For manufacturers of machinery for making round and square splint matches.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, wood fiber machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 6969.—For manufacturers of floral oil, such as is used in making perfumery.

Space with power, heat, light and machinery, if desired, in a large New England manufacturing concern, having more room than is necessary for their business. Address Box No. 407, Providence, R. I.

Inquiry No. 6970.—For manufacturers of working models of locomotives and steamboats, such as are displayed in ferry stations.

WANTED.—The patents or sole agency for Britain and France, of new machines and articles used in the Brewing and Allied Trades. Highest references given and required. State best terms with full particulars to "Wideawake," care of Streets Agency, 30 Cornhill, London, England.

Inquiry No. 6971.—Wanted, address of some model-making works and electrical novelty dealers.

Electrical and Mechanical Devices Manufactured. Inventors and others wishing to have specialties manufactured or estimates made as to the probable cost of manufacture, will do well to correspond with the undersigned. Frank Ridlon Company, Manufacturers of Specialties, No 200 Summer St., Boston, Mass.

Inquiry No. 6972.—For manufacturers of metal specialties.

Splendid opening for a high-grade mechanical engineer, who has had a broad experience in managing machine shops, the manufacture of machinery, engines and metal specialties. Applicants must be in prime of life and now employed. Preference will be given to applicants who have had modern scientific training in mechanical schools of high standing. Unqualified references will be exacted. All communications received will be regarded as strictly confidential. Address Mechanical Engineer, Box 773, New York.

Inquiry No. 6973.—For manufacturers of foot-power, coil-winding machines.

MOUNTAIN AND LAKE RESORTS.

Is the name of a beautifully illustrated publication of one hundred and twenty-eight pages just issued by the LACKAWANNA RAILROAD. The book contains a list of more than four hundred hotels and boarding houses among the various mountain and lake resorts reached by that road in New York, New Jersey and Pennsylvania. It suggests where to go, how to go, what it will cost and what can be seen and done when you get there. In addition there is a delightful love story entitled "A Paper Proposal," illustrated by well-known artists.

The book will be sent on receipt of ten cents in stamps addressed to T. W. LEE, General Passenger Agent, New York City.

Inquiry No. 6974.—For manufacturers of small gears for models.

2d-hand machinery. Walsh's Sons & Co., Newark, N.J.

Inquiry No. 6975.—For manufacturers of small gray iron castings ⅛ to 3-16 of an inch in thickness and about three inches long.

Inquiry No. 6976.—For manufacturers of creosote.

Inquiry No. 6977.—For manufacturers of soap machinery.

Inquiry No. 6978.—For manufacturers of an apparatus burning petroleum or kerosene that can be used in residences for heating hot water boilers.

Inquiry No. 6979.—For manufacturers of milk powder machinery.

Inquiry No. 6980.—For manufacturers of hand sewing machines to make Hessian flour and grain bags.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9664) N. D. M. says: I require to build a cement flume and penstock in connection with my flour mill here to obtain power by water wheels to operate my mill. I have 11-foot head of water, my dam backs the water back about 25 miles, spring freshets are heavy. I want the flume and penstock all one piece of work, same width and depth from pond to tail race, except in penstock where wheels will be. Now what would be the proportion of cement and sand or fine gravel used and how thick would the walls and end be at bottom and top to stand pressure, or if all the same thickness all the way up? Flume and pit in all would be about 50 feet long and 9 feet wide. Flume part would be in a bank of earth while penstock would be exposed. A. In reply to your inquiry, we would say that a concrete for such a piece of work as you describe should be made of 1 part of a good brand of Portland cement, 3 parts of good, clean, sharp sand, and 5 parts of broken stone or clean, coarse gravel, free from dirt or sand. It is impossible for us to advise you regarding the thickness of the walls or their required width at the base, without detailed information regarding every part of the work. The work which you suggest is too important for it to be wise for you to go ahead with it without having plans prepared for you by an expert engineer or one who has had wide experience in such matters.

(9665) W. H. M. says: Will you kindly inform the writer how many pounds a balloon 8 feet in diameter, inflated with approximately 258 cubic feet of the ordinary street gas, will be able to lift? A. One cubic foot of coal gas at 32 deg. F. weighs 0.0354 pound. One cubic foot of air at the same temperature weighs 0.0807 pound. One cubic foot of coal gas in a balloon will therefore be able to lift 0.0453 pound, and 258 cubic feet will be able to lift 11.7 pounds, provided the temperature of the gas and the air is 32 deg. F. If it is 70 deg. F., this amount will be reduced to 10.8 pounds.

(9666) J. T. R. asks: Will you please favor me with the recipe for making concrete for sidewalks, something that I can guarantee not to crack. A. In order to make a thoroughly first-class cement sidewalk, proceed as follows: First, put in about six inches of clean, dry cinders. On top of this put six inches of concrete, made up as follows: 1 part of Portland cement, 3 parts of clean, sharp sand, 5 parts of good broken stone. This concrete should be thoroughly rammed in place until the water appears at the surface at every point. After the concrete is set, cover it with a coating, about 1½ or 1¾ inches thick, made up of equal parts of best Portland cement and clean, sharp sand. The latter should be troweled to a smooth, even polished surface. The concrete, if required in small quantity, can be most easily mixed by hand, turning the mixture of cement, sand, and stone with shovels until they are evenly distributed through the mass. If very large quantities are needed, it is more economical to do this mixing by machinery. The cost of concrete will depend very much upon the locality in which the work is done and the quantity desired. It should not, under ordinary circumstances, exceed about $6 per cubic yard.

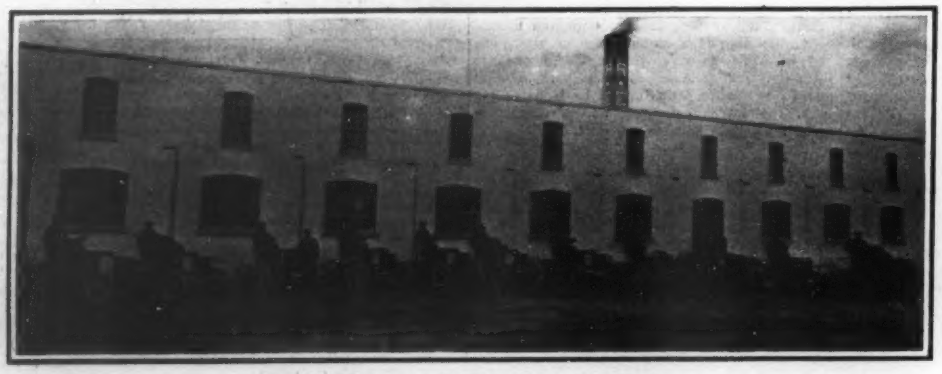
(9667) B. G. asks: 1. I have been asked why it is that cream came to the top of milk. Now, the specific gravity of cream is greater than milk, so why should it float? A. Your difficulty in understanding the rising of cream upon milk, and its separation in a separator, is due to your statement that the specific gravity of cream is greater than that of milk; this is not the case. Milk is heavier than water, its specific gravity ranging from **1.029 to 1.034 at 60 deg. F.** A quart of water weighs 2 pounds 1.38 ounces. A quart of milk weighs 2 pounds 2.38 ounces on the average; if it contains a larger per cent of butter fat it will weigh less, and if less butter, fat it will weigh more. Since fat is lighter than water, the more fat it contains the less the milk weighs, unless the lime and other solids which are heavier than water are also in greater proportion. So, also, milk is heavier after the fat has been removed. Skim milk has a specific gravity from 1.033 to 1.037. Cream, therefore, comes to the top of milk which is

THE PRODUCTION OF AUTOMOBILES ON A LARGE SCALE.

HOW A MILLION DOLLAR AUTOMOBILE PLANT WAS DESIGNED AND SET IN OPERATION.

From the projecting of an automobile factory to the producing of 1,000 machines in nine months is a record that stands unparallelled in the automobile industry. Yet such is what has actually been accomplished under the management of that pioneer inventor in the field of the new locomotive—Mr. R. E. Olds. After having produced the first practical runabout for the man of average means, Mr. Olds was induced to turn his inventive ability to the production of a popular-priced, powerful touring car. The Reo Motor Car Company was organized August 27, 1904, for this purpose, and in less than thirty days an experimental factory was in full operation, producing the first Reo touring car. This machine made its debut on the road on the afternoon of October 14, during the course of which it displayed its fleetness and covered seventy miles. During the remainder of the fall this original Reo touring car covered over 2,000 miles.

So rapidly did the work of planning the large factory and surveying the ground for the same progress, that by September 15 this was accomplished, and ground was broken on the twenty-five acre site obtained by the company. This site is directly opposite the Grand Trunk passenger station, and it faces on the main street of Lansing. The Grand Trunk tracks bound it on the north, and the Lake Shore tracks on the east. Double side tracks are provided by both railroads, and, although the company's shipping facilities are of the best, at present a frequent sight is that shown in the middle left-hand cut, which depicts a trainload of Reo touring cars blocked on the siding. A very good idea of the general appearance of the factory, with its large testing track, can be had from the cut depicting the same, while the other views show the making of parts (such as flywheels, cylinders, etc.), the assembling of the chassis, and the finished chassis being tested before the boilers are mounted on them and the finishing touches given. Not only is all the machine work done in the new factory, but the bodies, also, are built, upholstered, and painted. Thus every part of the machine is made in the huge plant, which comprises altogether four two-story buildings, arranged as shown in the cut.



Outside Testers at the Reo Motor Car Works.

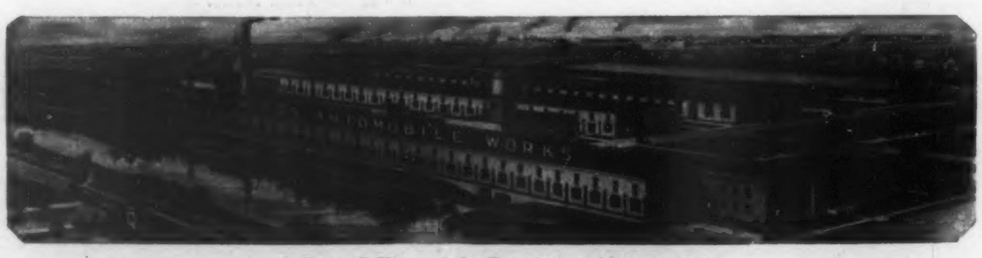
Not only has the Reo Company turned out about 1,000 machines since the installation on December 15 last of the machinery in the first 75 x 800-foot building to be completed, but it recently startled the spectators at the Empire City Track Decoration Day races by defeating a 40-horse-power foreign racing car by one-fifth of a second with its "Reo Bird" racer, having two 16-horse-power stock engines coupled together and placed on a light chassis. The three miles were covered in 3 minutes 20 4-5 seconds, or at 53¾ miles an hour; and although this is remarkable time for a machine of but 32 horse-power and less than 1,432 pounds weight, any stock Reo touring car can be depended upon to travel 40 miles an hour, or over, at the will of the driver. Besides the touring car at $1,250, the company also builds a single-cylinder runabout at the price originally set by Mr. Olds—$650. Both of these machines are constructed with great care, of the best materials obtainable, and the possessor of either of them will find he has an automobile of comparatively small first cost, greatly reduced cost of maintenance, and a large percentage of dependability, which is the most desirable feature of any self-propelling vehicle.

Mr. R. E. Olds.

While the work accomplished by the Reo Motor Car Company is remarkable, it is no more than might be expected when we consider Mr. Olds' past records and experience in gas engine and automobile manufacturing. The Reo Company will soon put out a commercial car that will be so low in first cost that the horse cannot compete with it.

"Blocked on the Siding." Two Days' Shipments at the Reo Works.

The Road Testing Department.



A General View of the Reo Automobile Works.

Main Machine Shop at Reo Works, Where 5,500 Parts Are Made Daily.

Reo Chassis in the Paint Shop. Hundreds of Reos May Here Be Seen.

WHERE THE REO AUTOMOBILE IS MADE.

set away in quiet, because the cream is lighter than the rest of the milk. Butter also, after it is worked, floats in water or milk. Our figures are taken from a government report on the subject and may be received as reliable. 2. If a train weighing 400 tons is pulled by an engine that takes it at the rate of 35 miles an hour over a level track, what must be its power? A. On a level track, at a speed of 30 miles per hour, the train resistance varies from 13 to 17 pounds per ton. This multiplied by the number of feet traveled per minute, and divided by 33,000 will give the useful power exerted by the engine in horse-power.

NEW BOOKS, ETC.

PORT ARTHUR A MONSTER HEROISM. By Richard Barry. Illustrations from photographs taken on the field by the author. New York: Moffat Yard & Co., 1905. 12mo. 18 illustrations, 344 pages.

The author of this work is a young newspaper man who, at the opening of the war, set out for the scene of conflict with a small camera, small resources, and even smaller experience. But he possessed unbounded confidence and patience—qualities that held him at Tokio, when other correspondents were leaving in disgust at the delay—and finally landed him at no less a place than the Japanese lines before Port Arthur.

With such splendid opportunities for acquiring information, the author should have come home with ample material to write a clear, concise, and connected story of the siege. His photographs and facts, as given in this book, show that he has gathered the material; but unfortunately he has failed to arrange and relate his facts in the simple, straightforward style demanded by a subject so intricate and, to the outsider, so confusing, as this siege.

We could wish that Mr. Barry had followed throughout his book the direct and lucid style of the introduction, which is in such strong contrast to the heroics and "fine writing" of the book itself, as to make us suspect that some friendly pen has come to his relief. If the author had taken this introduction as the mesh, and woven into it the simple story of the facts as he saw and photographed them, he would have written a better, because a more understandable book.

At the same time, it must be admitted that the work is genuinely interesting; and as a series of thrilling, if disconnected, word-pictures by an eye-witness of the greatest siege of modern times, it will well repay perusal.

THE AUTOMOBILE POCKETBOOK. By E. W. Roberts, M. E. Cincinnati: The Gas Engine Publishing Company, 1905. 32mo.; pp. 329. Price, $1.50.

This small volume gives very concisely a great deal of information essential to the automobilist. It is intended as a pocket handbook and, therefore, has been made small in size—3½ x 5¼ inches—and bound in flexible leather covers. Besides describing all the main parts of a gasoline automobile, and telling how to repair them when anything about it breaks down, Mr. Roberts gives hints on how to operate a car, and a chapter of "Don'ts," which tells what to avoid. There are many useful points regarding automobile designing which are discussed in the book. One chapter in particular that will be of interest is that telling how to make a brake test of a gasoline motor. The book is completed with an index. It is the best small volume on the automobile which we have seen thus far.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending June 13, 1905

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Adding machine, C. W. Horn 792,041
Advertising device, G. F. Bagby 791,997
Aeronautic apparatus, G. McMullen 792,154
Air brake angle cock holder and pipe clamp, railway car, R. H. Jones 792,137
Air mixer, T. M. Dudgeon 792,323
Alarm and controller for sprinkler tanks, etc., automatic, H. E. Reeve 792,237
Animal dipping tank, A. A. Kramer 792,130
Antimony, electrodepositing, A. G. Betts 792,307
Ash or garbage can, L. A. Harker 792,027
Automatic sprinkler, C. E. Buell 792,309, 792,310
Automatic sprinkler, R. W. Newton 792,343
Automobile dray, W. G. Thompson 792,561
Automobile folding top, W. N. Beecher 792,112
Baker's peel, R. L. Corby 792,400
Baling press, P. C. Southwick 792,359
Baling press, J. H. Pitkin 792,448
Basket or crate, Morley & McAtee 792,061
Battery. See Galvanic battery.
Bearing and ladder support, upper tumbler, Knox & Ferris 792,522
Bearing for motor vehicles, wheel, A. Stechbarth 792,559
Bed rail locking device, A. H. Hampton 792,329
Bed spring bottom, B. Jungnickel 792,520
Bedstead clothes rack attachment, W. J. Dick 792,405
Bedstead construction, A. Taylor 792,366
Boiler, H. Molendo 792,535
Boiler cleaning compound, C. & E. H. Salazar 792,402
Boiler tube blower, G. E. Averill 791,906
Boiler tube cleaner, E. M. Adams, reissue 12,355

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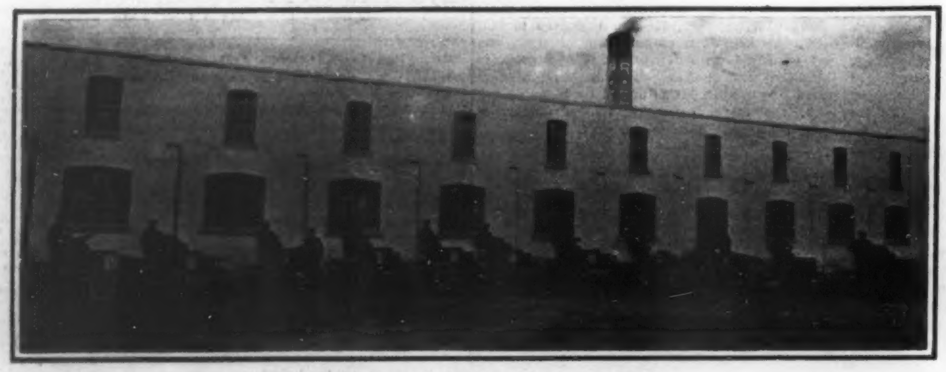

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So rapidly did the work of planning the large factory and surveying the ground for the same progress, that by September 15 this was accomplished, and ground was broken on the twenty-five acre site obtained by the company. This site is directly opposite the Grand Trunk passenger station, and it faces on the main street of Lansing. The Grand Trunk tracks bound it on the north, and the Lake Shore tracks on the east. Double side tracks are provided by both railroads, and, although the company's shipping facilities are of the best, at present a frequent sight is that shown in the middle left-hand cut, which depicts a train-load of Reo touring cars blocked on the siding. A very good idea of the general appearance of the factory, with its large testing track, can be had from the cut depicting the same, while the other views show the making of parts (such as flywheels, cylinders, etc.), the assembling of the chassis, and the finished chassis being tested before the boilers are mounted on them and the finishing touches given. Not only is all the machine work done in the new factory, but the bodies, also, are built, upholstered, and painted. Thus every part of the machine is made in the huge plant, which comprises altogether four two-story buildings, arranged as shown in the cut.

Mr. R. E. Olds.

Not only has the Reo Company turned out about 1,000 machines since the installation on December 15 last of the machinery in the first 75 x 800-foot building to be completed, but it recently startled the spectators at the Empire City Track Decoration Day races by defeating a 40-horse-power foreign racing car by one-fifth of a second with its "Reo Bird" racer, having two 16-horse-power stock engines coupled together and placed on a light chassis. The three miles were covered in 3 minutes 20 4-5 seconds, or at 53¾ miles an hour; and although this is remarkable time for a machine of but 32 horse-power and less than 1,432 pounds weight, any stock Reo touring car can be depended upon to travel 40 miles an hour, or over, at the will of the driver. Besides the touring car at $1,250, the company also builds a single-cylinder runabout at the price originally set by Mr. Olds—$650. Both of these machines are constructed with great care, of the best materials obtainable, and the possessor of either of them will find he has an automobile of comparatively small first cost, greatly reduced cost of maintenance, and a large percentage of dependability, which is the most desirable feature of any self-propelling vehicle.

While the work accomplished by the Reo Motor Car Company is remarkable, it is no more than might be expected when we consider Mr. Olds' past records and experience in gas engine and automobile manufacturing. The Reo Company will soon put out a commercial car that will be so low in first cost that the horse cannot compete with it.

"Blocked on the Siding." Two Days' Shipments at the Reo Works.

The Road Testing Department.

A General View of the Reo Automobile Works.

Main Machine Shop at Reo Works, Where 5,500 Parts Are Made Daily.

Reo Chassis in the Paint Shop. Hundreds of Reos May Here Be Seen.

WHERE THE REO AUTOMOBILE IS MADE.

set away in quiet, because the cream is lighter than the rest of the milk. Butter also, after it is worked, floats in water or milk. Our figures are taken from a government report on the subject and may be received as reliable. 2. If a train weighing 400 tons is pulled by an engine that takes it at the rate of 35 miles an hour over a level track, what must be its power? A. On a level track, at a speed of 30 miles per hour, the train resistance varies from 13 to 17 pounds per ton. This multiplied by the number of feet traveled per minute, and divided by 33,000 will give the useful power exerted by the engine in horse-power.

NEW BOOKS, ETC.

PORT ARTHUR A MONSTER HEROISM. By Richard Barry. Illustrations from photographs taken on the field by the author. New York: Moffat Yard & Co., 1905. 12mo. 18 illustrations, 344 pages.

The author of this work is a young newspaper man who, at the opening of the war, set out for the scene of conflict with a small camera, small resources, and even smaller experience. But he possessed unbounded confidence and patience—qualities that held him at Tokio, when other correspondents were leaving in disgust at the delay—and finally landed him at no less a place than the Japanese lines before Port Arthur.

With such splendid opportunities for acquiring information, the author should have come home with ample material to write a clear, concise, and connected story of the siege. His photographs and facts, as given in this book, show that he has gathered the material; but unfortunately he has failed to arrange and relate his facts in the simple, straightforward style demanded by a subject so intricate and, to the outsider, so confusing, as this siege.

We could wish that Mr. Barry had followed throughout his book the direct and lucid style of the introduction, which is in such strong contrast to the heroics and "fine writing" of the book itself, as to make us suspect that some friendly pen has come to his relief. If the author had taken this introduction as the mesh, and woven into it the simple story of the facts as he saw and photographed them, he would have written a better, because a more understandable book.

At the same time, it must be admitted that the work is genuinely interesting; and as a series of thrilling, if disconnected, word-pictures by an eye-witness of the greatest siege of modern times, it will well repay perusal.

THE AUTOMOBILE POCKETBOOK. By E. W. Roberts, M. E. Cincinnati: The Gas Engine Publishing Company, 1905. 32mo.; pp. 329. Price, $1.50.

This small volume gives very concisely a great deal of information essential to the automobilist. It is intended as a pocket handbook and, therefore, has been made small in size—3½ x 5¼ inches—and bound in flexible leather covers. Besides describing all the main parts of a gasoline automobile, and telling how to make repairs when anything about it breaks down, Mr. Roberts gives hints on how to operate a car, and a chapter of "Don'ts," which tells what to avoid. There are many useful points regarding automobile designing which are discussed in the book. One chapter in particular that will be of interest is that telling how to make a brake test of a gasoline motor. The book is completed with an index. It is the best small volume on the automobile which we have seen thus far.

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Weighing and delivering apparatus, beet, J. S. Eash... 792,406
Weir, H. Herzig... 792,517
Well drill, oil, J. E. Downer... 792,322
Well piston or plunger, deep, C. M. Ray... 792,349
Welts into stitched seams, guide for introducing corded, O. E. Brown... 792,116
Wheel. See Car wheel.
Wheel, H. T. Hansen... 792,028
Winding machine, S. W. Wardwell... 792,565
Wire, film coated, J. G. Callan... 792,001
Wire, making ingots for seamless gold plated, H. M. Williams... 792,098, 792,099
Wires or bars to pieces of metal, plug or bush for connecting, E. A. Richardson, reissue... 12,350
Wrench, S. B. House... 792,213
Wrench, J. W. Woodard... 792,487
Wrench, W. H. F. Tenny... 792,560
Yoke, harness, W. G. Parker... 792,069

DESIGNS.

Badge, C. J. Dieges... 37,461
Chair frame, W. H. Redmond... 37,462

LABELS.

"Banzai," for a tonic, S. Hochstadter... 12,207
"Cauffman's," for ginger brandy, E. Cauffman & Co... 12,206
"Dixie Flake," for a confection, Robert A. Johnston Co... 12,196
"Linfa," for cigars, Cole Lithographing Co.. 12,107
"Lowry's Red Cordial," for a medicine, J. I. Lowry... 12,199
"Lyric Record," for talking machine records, International Record Co... 12,209
"M C Split," for mineral water, Ponce de Leon Mineral Water Co... 12,200
"Mme. Wilbur's Eureka Face Cream," for a cosmetic, E. W. Prather... 12,195
"Mozart Record," for talking machine records, International Record Co... 12,208
"Nica Pana," for cigars, Schmidt & Co... 12,198
"Our Home Comfort," for coffee, Vogel Bros. & Co... 12,201
"Selby Blue and Gold Brand," for white lead, Selby Smelting and Lead Co... 12,210
"Trimble," for whisky, White, Hentz & Co... 12,202 to 12,205

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"Still Alarm and Summer Backs, Congress Playing Cards," for playing cards, United States Playing Card Co... 1,348

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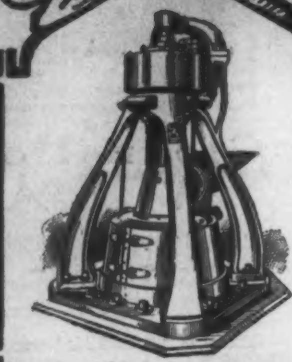

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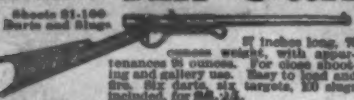

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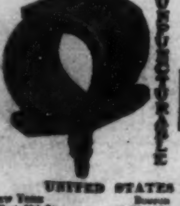

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